The Electrical World.

VOL. XXVII. NEW YORK, JANUARY 18, 1896. No. 3.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

253 Broadway, New York.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. *Cable Address: "Electrical," New York*

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,

in the United States, Canada or Mexico; other foreign countries, $6.

In requesting your address changed give OLD as well as new address.

Now in its third decade, THE ELECTRICAL WORLD is the Pioneer Electrical Journal of America, and has well maintained its lead. It has the largest Circulation of any electrical periodical, and is the best Advertising Medium.

THE ELECTRICAL WORLD'S Advertising Rates are much lower than those of any other similar publication, circulation considered, and vary according to space, position and number of insertions. Quotations promptly furnished.

Address and make drafts, orders, etc., payable to

THE ELECTRICAL WORLD,

253 Broadway, New York.

VOL. XXVII. NEW YORK, JANUARY 18, 1896. No. 3.

CONTENTS.

Editorial..... 69
The Past Year in England..... 71
The Van Depoele Trolley Case..... 71
Northwestern Electrical Association..... 71
The Pollak Rectifier..... 72
Three-Phase System at Concord, N. H..... 73
London Underground Electric Railway..... 74
Central-Station Working—III., by George T. Hanchett..... 75
Electric Railway Work in the Immediate Future..... 76
The Electrical Manufacture of Aluminum..... 77
Electrical Resonance, by A. S. Dunstan..... 79
Fly-Wheel Accidents..... 80
Regulating and Starting Rheostats, by H. Ward Leonard..... 81
Invention of the Electromagnetic Telegraph, by J. Cummings Vail... 81
Digest of Current Technical Electrical Literature, Compiled by Carl Hering..... 82
A New Alternating-Current Motor..... 87
An Electric Chain Hoist..... 87

DEPARTMENTS:

Financial Intelligence..... 88
Special Correspondence..... 88
General News of the Week..... 89
Trade and Industrial Notes..... 90
Business Notices..... 90
Illustrated Record of Electrical Patents..... 91

ENGINEERS' CLUBS.

There is a movement on foot at Chicago to establish an engineers' or technical club, and the unqualified success of the New York Engineers' Club offers a sufficient argument in its favor. The rather sad experience with electric clubs can have no application in this case, as the membership would doubtless, as in New York, comprise every branch of engineering and technical science, and thus eliminate the "shop-talk" atmosphere which has proved so fatal to clubs whose membership was all confined to one pursuit. There is an abundant opportunity in all of our large cities for the formation of clubs of this character, but the professional basis should not be made to serve any other purpose than to unite men who, from their callings, are apt to have congenial tastes. Otherwise it would be desirable for the bodies not to differ from other social clubs, and such features as lectures, scientific conversaziones, etc., should be left for the professional societies to take care of. It is even problematical if a technical library or complete files of professional journals would be desirable additions, as more promise of complete success is offered by keeping such clubs on a purely social basis, and with nothing introduced to encourage "shop-talk." Not that professional subjects should be entirely "tabooed," for one of the most interesting features of such clubs is the occasion they offer for members of different branches of the general profession to compare notes, which is refreshing rather than the reverse, as is the case when in the evening the same matters which formed part of the day's work are brought up in a club confined to one branch.

RESONANCE.

The article in another column by Prof. Dunstan, on resonance, is a simple mathematical treatment of a subject that usually has been presented in such terms as to require a special knowledge of mathematics to grasp. Dr. Pupin in his classical papers of several years ago treated the subject from the physical standpoint, and Drs. Bedell and Crehore in their Chicago congress paper, and in a subsequent paper printed in the *Physical Review*, gave it a very thoroughly mathematical exposition. The remarks of Steinmetz in the discussion of Dr. Pupin's 1894 Institute paper gave the simplest view of the phenomenon yet presented, and the more recent Institute paper of Houston and Kennelly developed it from the graphical standpoint and pointed out the limitations in practical application. It cannot, therefore, be said that resonance has not received ample treatment, yet we very much doubt if few besides those who have written upon it have any very clear ideas as to the real character of the phenomenon. The mathematical method of presenting a new subject is not of much assistance in enabling a real understanding of it to be had, though, as here employed by Prof. Dunstan, it has not the additional disadvantage of requiring other than an ordinary knowledge of mathematics. The physical treatment thus far has been largely based upon mechanical analogies, but the analogies offered by the vibrations of cords and springs are only of service to those who have a thorough understanding of the principles involved; to others it is merely a case of avoiding the rock of Scylla to become engulfed in the whirlpools of Charybdis. It seems inevitable, however, that in the first stages of any subject it should have an elusive character, as far as obtaining concrete ideas is concerned. For more than a quarter of a century the principle of inductance was concealed in mathematical terms, and reactance under the name of the electromagnetic function was merely a term which, like the thermo-

dynamic function, was thus specifically designated for convenience on account of persistently turning up in mathematical expressions. It is to be hoped that resonance may before long be presented in terms that will be understood by those to whom mathematics do not appeal, and without the aid of analogies that to many present as great difficulties as the main subject itself.

ELECTRICAL MISINFORMATION.

The reader who derives his information entirely from the newspaper press is indeed fortunate if he possesses a single correct idea on electricity or its applications. It would almost appear that those who write for the general public on technical subjects possess such a supreme contempt for their audience that they consider it only worthy of being fed with the scraps contemptuously cast aside by those who know, or with speculations manifestly ridiculous to even the first year student in electricity. Unfortunately, much of this electrical misinformation is imparted by those who are supposed to have a standing in electrical circles. When an article is ordered of one of these for a popular audience, instead of giving the subject and the manner of presentation the careful study always necessary in order to intelligently address a lay audience, he finds it much easier to collect the odds and ends of visionary speculation and present them in a picturesque garb, or to take unmature subjects and write of them as if they were actual practical accomplishments. It may be said that this matter is good enough for those who merely wish to be interested for a half hour and with no idea of applying the information thus presented to them, or that the public would not care to read articles on scientific subjects that did not consist of matter of a striking or paradoxical character. The first assumption involves a moral question, both with respect to the matter furnished and those who write it. Leaving aside the former aspect, those who, knowing its meritricious scientific character, yet furnish such matter, can be considered only as panderers, and whose trading for profit upon their connection with a profession should meet with public repudiation. Such as these cannot plead the excuse of the existence of a demand, for their acquiescence in an unworthy object reflects discredit upon the entire body with which they are connected. Tyndall, Procter and many other scientific writers have shown that the most difficult technical subject can be presented in its true character and yet be made highly interesting, but—and this is the vital point—much study and labor is necessary to accomplish this result. The class of writers to which we refer, however, when they receive from a syndicate or newspaper an order for an article, have no regard of the responsibility involved from their connection with a profession, but proceed to misrepresent it by hastily stringing together a collection of speculations, which are offered and accepted as a true representation of the case under consideration. They thus deliberately deceive the public and at the same time betray the profession for the few dollars which their connection with it thus brings their way.

THE EDUCATION OF ENGINEERS.

President Drown on Founders' Day at Lehigh University, delivered an address on "The Educational Value of Engineering Studies," in which he lays down the proposition that engineering education should not be based upon the idea that young men are strictly professional students on the one hand, or that they are learning a trade or handicraft on the other. He refers to the great zeal shown by many teachers to prepare their students for practical life by drilling them laboriously in the class-room and shops in those operations which will serve them in good stead when they begin work for themselves, but adds that it often lacks the discretion which the true educator of youth should apply to the problem. He considers that the experimental work and original investigations which find a place in the best engineering schools, are the most valuable training that the student receives, and of the highest educational value, imparting habits of logical, accurate and precise thinking, which are of more permanent value to him than all of his store of facts. President Drown favors the introduction in every engineering course of a certain amount of culture studies, pursued side by side with the scientific and technical ones. He favors a course, regarded as a whole, which is mainly one of mental development and training, designed to fit a student to adapt himself to new conditions, and render him quickly and intelligently responsive to the demands of his employers, and that a little, more or less, of this or that study or practice is not of such great moment as to justify the barring out of studies which would make him a more perfectly rounded and permanently useful man. Much stress is laid upon the importance of a thorough course in the English language and literature, and the statement made that it is, if possible, more important even that the student should be proficient in the writing of English than the collegian, for the ability to express himself clearly and accurately may be said to be a tool of his trade, as he has to write reports and prepare specifications, the very soul of which is brevity. Besides, to write one's mother tongue correctly is the hall-mark of the educated man, and President Drown believes it to be a grave wrong on the part of any school or college to fail to provide suitable instruction to this end. The characteristics of a course in engineering are enumerated as follows: 1. A thorough class-room drill in the fundamental principles of his profession. 2. The broadening and humanizing influence of culture studies throughout the course. 3. The formation of good mental habits. 4. Careful guidance in the realm of original research. We have quoted at some length from the address of President Drown, as he presents what may be called the modern view of engineering education, as contrasted with that which even a few years ago was predominant in this country, and still guides many of our technical schools. According to the former view, the main object is to educate the mind of the student, instill principles, and influence his character, leaving strictly practical things to be taught through experience when the graduate begins his life-work. The other method is to cram the student's mind with practical information, and teach him manual dexterity so that upon graduation he may at once become an actual wage-earner. As to which method is the better seems scarcely open to argument if the entire life of the graduate is considered and not the first few years after graduation alone. In this connection we may again repeat the remark of the late Hon. Eckley B. Coxe, a large employer himself of professional men, that he had noticed that while the young man of a practical technical training would at first have the advantage over the liberally educated graduate, in a few years the latter invariably out-distanced him. A short time before his death the late Franklin Leonard Pope remarked that he thought the most successful electrical engineers of the future would be those who had received a college education before taking up their technical studies, and shortly after called attention to a confirmation of this view in the fact that in a list which had just then come under his notice, of a number of successful electrical engineers, every one had received a liberal education before taking up engineering.

Witty Japs.

Our little neighbors to the west evidently enjoy American wit, for we notice in our Japanese contemporary, *The Electrical Friend*, among a few sentences and words, printed in English letters, although up-side down, the following clipping from *Life*: "'The telephone is like a woman; it tells everything it hears.' 'Yes, that's so, and 'tis unlike a woman, too; it tells a thing just as it hears it.'" There appears to be no explanation in parenthesis accompanying this, which shows that, unlike some of our European cousins, the Japs can understand an American joke without an explanation as to the point.

The Van Depoele Trolley Case.

In the United States Circuit Court at New Haven, Conn., on Jan. 11, Judge Townsend refused a hearing in the Van Depoele fundamental trolley case, and denied an injunction asked against the Westinghouse Company, on the grounds that it had not appeared as a party to the suit.

A New Chicago Railway Syndicate.

It is reported that John D. Crimmins, of New York, is interested in the syndicate which recently obtained the passage of an ordinance by the Chicago Council, giving the right to run electric cars on the south side of the streets not used by the Chicago City Railway Company. Ex-Congressman Lawrence McGann is said to have engineered the measure through the Council, and is now president of the General Street Railway Company. The capitalization of the company is $5,000,000.

Northwestern Electrical Association.

At the meeting of the Northwestern Electrical Association at the Hotel Pfister, Milwaukee, Jan. 15, 16 and 17, the following papers will be read:

"Modern Apparatus and Existing Conditions," by W. C. Buckley; "Economic Expression for Fuel Value," by A. V. Abbott; "Storage Batteries in Central Stations," by Maurice Barnett; "Some Facts About Acetylene Gas," by J. C. McMynn; "Power Transmission Plants," by E. R. Cunningham; "The Upbuilding of a Small Town," by Fred De Land. The sessions will be held at the Hotel Pfister.

Standard Rules for Electrical Construction.

The date of the meeting of the representatives of the various electrical associations who were to consider the adoption of a standard set of rules for electrical construction and operation, has been changed from Jan. 18 to March 18. A committee of the National Electric Light Association having the matter in charge, invited, several months ago, the American Institute of Electrical Engineers, the American Street Railway Association, the National Board of Fire Underwriters, the International Fire Chiefs Association, the American Institute of Architects, the American Bell Telephone Company, the Western Union Telegraph Company, the Postal Telegraph Company, the General Electric Company and the Westinghouse Company, to co-operate in forming a joint committee to consider generally the subject of electrical rules with a view to securing the promulgation and enforcement of one standard set of rules for electrical construction and operation. Mr. W. J. Hammer, chairman of the original committee, reports that nearly all those invited to send a delegate to the joint committee have accepted.

Brooklyn Bridge Car Telephones.

Mr. Kingsley L. Martin, assistant engineer of the Brooklyn Bridge, has devised a system of telephonic communication whereby gripmen and train dispatchers may be kept in constant communication. The system comprises a double wire alongside the track a foot or so from the outer rail, with trolleys running down from the edge of the car platform. Electrical contact is made with the trolley wire by means of a copper leaf brush, which prevents the noises that rendered conversation impossible with different forms of trolleys which were tried. It is proposed to have a telephone at either end of each train, the transmitter being fastened on the iron upright that supports the hood of the roof over the car platform, and mounted on springs, so as to prevent disturbing vibration, and suspended right in front of the face of the gripman. The receiver will be ordinarily hung up as in offices, but doing rush hours and in foggy weather the gripman will wear it constantly at his ear. The train dispatchers at the New York and Brooklyn sides will have telephone transmitters before them in the offices just as the gripmen, but will have the receivers at their ears, not only during rush hours and foggy weather, but at all other times when they are on duty. By this means there will be constant and direct communication with the rear and front of trains in transit across the bridge, and the dispatcher can, consequently, be informed instantly of anything that may happen, and will thus be in a position to act promptly.

Steam Turbines.

The London *Electrician* states that the results of recent trials indicate that, although the Laval steam turbine can hold its own beside many modern steam engines, it is not quite equal to the Parsons turbine in economy.

The Past Year in England.

(From Our Own Correspondent.)

Although the "forward party" in electrical engineering circles in England would have us believe that electric lighting, if it has not already become quite a secondary branch of the electrical industry in this country, will shortly do so, the idea has not yet been borne out by the facts. Electric traction, which we were told at the beginning of the year, would almost put the electric light out by the end, has made a very poor show. Notwithstanding the persistent exordiums of certain sections of the electrical press, the British public generally, and municipalities and tramway companies in particular, still hold aloof from the trolley, and the net addition to our electric tramways in the past twelve months have been three small lines, one at Bristol, one at Coventry and one at Dublin, and an interesting mountain railway in the Isle of Man. The Central London Railway has at last been commenced, and the City & Waterloo tunnel is being steadily burrowed. The air also is thick with schemes, and, no doubt, if we go on prophesying long enough that the electric traction boom is at hand, we shall one day be true prophets. The electric-light supply business, however, is not by any means in the shade yet. It is progressing healthily and steadily. New stations continue to come into operation, and old stations continue to add to their lamp connection. At the present moment the electric light undertakings in the metropolis have a total connection of close upon 1,200,000 8-cp lamps, the lamps being nearly evenly divided between continuous and alternating currents. The total for 1894 was under a million, so that there has been an increase during the past year of about 24 per cent. A striking feature is that there are as yet no signs of what one may call "electrical saturation" in the Metropolis. If we plot out the curves of the lamp connections of the various companies at the end of each year since they came into operation in 1890, these curves show no signs of bending, indeed, those of the Metropolitan Company (257,000 8-cp lamps) of the Westminster Electric Supply Corporation (210,000 8-cp lamps), and of the City of London Electric Lighting Company (195,000 8-cp lamps) show a tendency to go upwards at a somewhat sharper rate than before. In the provinces there is now a total lamp connection of 1,100,000.

The total at the end of 1894 was about 670,000, so that there has been an increase in the lamp connection of the provinces of about 64 per cent. The total lamp connection of the United Kingdom, therefore, amounts now to 2,300,000 8-cp lamps; 1,500,000 belonging to companies, and close upon 800,000 belonging to municipalities. The most noteworthy event in central station work this year has been the 220-volt lamp question, which has been initiated by two or three enterprising central station engineers, much against the wishes of older heads, who are now fitfully sprinkling their warnings over various periodicals. There can be no doubt that there is amongst well-informed men not unduly cautious, a feeling of considerable disquiet with regard to the forthcoming submission of wiring and fittings intended for 100 volts, and hardly able to withstand that pressure, to a pressure amounting to more than double that figure.

The recent recommendation of the Expert Committee, appointed by the Board of Trade, to allow the neutral of a three-wire system to be earthed and to permit a pressure of 500 volts across the "outers," settles at one blow two questions which have for a long time agitated the minds of our three-wire station men. I recently alluded at some length to the remarkable conference at the Westminster Town Hall between the officials of the Board of Trade and the engineers of our electric lighting stations, the subject of their deliberations being the revision, in a mutually satisfactory manner, of the Board of Trade regulations dealing with electric supply and the public safety.

Outside the electric light industry there is not much to chronicle. Cable circles in this country have been much agitated during the past twelvemonth by the evident intention of the French Government to free itself, at any cost, from what it is pleased to term "English domination" in cable matters. Whether the thing is possible, and, if possible, whether the game is worth the candle, time alone will show. The British Pacific cable scheme, also, I am glad to say, has made a decided step forward, and there seems every chance that for once in a way a cable will be laid by this country on urgent national grounds, as well as on purely commercial grounds. It is evidently about time we began to look at matters of this kind in a broader way than heretofore, if only to preserve our commercial hegemony.

An interesting development in submarine telegraphy was the commercial utilization in April last of "induction" telegraphy between the Isle of Mull and the mainland of Scotland, on the occasion of the breaking down of the regular cable. Another development of almost equal interest was the successful establishment and maintenance of telegraphic communication with the well-known Fasnet Rock lighthouse, by means of the "discontinuous" cable system. This system has, so far, withstood the winter storms.

In telephony there has been no technical advance worth mentioning, and the telephonic imbroglio still continues. Patent litigation has been remarkably scarce, and no case of great interest is pending. The Institution of Electrical Engineers has been shaken to its base, as the historians would say, by agitation on the part of the youthful members who wish to impart a little more vigor and a little more skill into its administration, and a wholesale emendation of its rules and regulations is contemplated.

In electrical manufacturing circles there have been endless complaints of the severity of competition, and of the necessity under which several firms have been to take contracts at less than cost price in order to keep their plant employed. Nothwithstanding the continued extension of electric lighting, there can be little doubt that there are still far too many manufacturing firms in the business. This is all the more evident when we remember that our big mechanical engineering firms are now rapidly organizing electrical departments, and with their long business experience and wide connection, and appliances for turning out cheap plant, the competition of these mechanical engineering firms must inevitably have the effect of still further lowering the low prices brought about by the internecine competition of the electrical engineering firms pure and simple. In short, while the electric light supply business in this country has, during the past twelvemonth, been extremely prosperous and progressive, the same cannot be said of the electrical manufacturing business, and there are not, at the beginning of the new year, many decided signs of improvement.

The Pollak Rectifier.

We reproduce the accompanying cuts from a report made by the United States Consul at Frankfort, Germany, giving an account of the Pollak apparatus for transforming alternating into pulsating currents.

The station shown in Fig. 2 obtains its current from the Frankfort Municipal central station, at a voltage of 3000, which by means of a

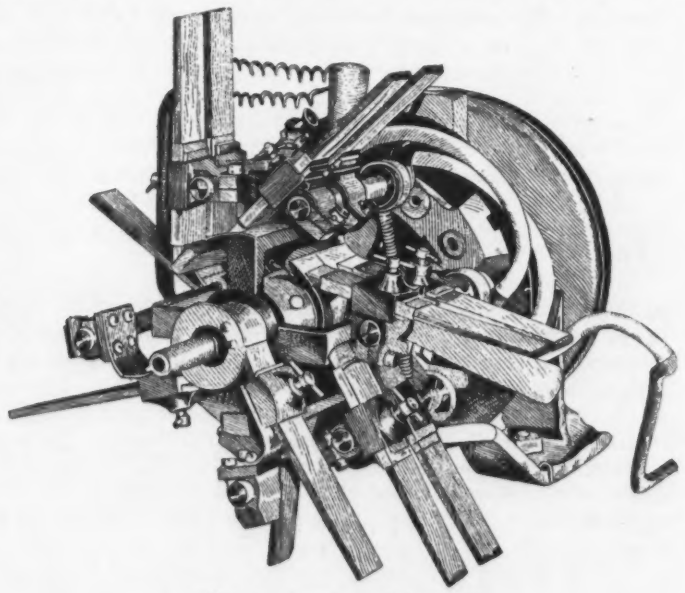


Fig. 1.—Pollak Rectifier.

transformer is reduced to 65 volts. The low voltage current enters the rectifier by the rings shown in Fig. 1, and is taken off by four rows of adjustable brushes, the first and third and the second and fourth being connected with each other.

The rectifier is turned by a synchronous motor of small dimensions, which receives its alternating currents, likewise reduced to 65 volts, from a small special transformer provided for that purpose. The outer circuit of the continuous current, which passes from the rectifier, includes an automatic disconnector, a fluid-resistance ammeter, and, in various parallel shunts, electric motors and cells with their voltmeters and other apparatus. The converted current produced by the rectifier is not entirely continuous, but pulsating, the length of the pulsations being governed by the width of the commutator bars and the speed of the central generator. The duration of contact can be regulated by adjustment of the brushes, and this adjustment is so made that the motive force of the current shall not fall below that of the battery, which would otherwise charge back into the circuit.

Four of these rectifiers, each for 350 amperes, have been in continuous service day and night at the works of the company in Frankfort for more than a year, with such complete success, Consul Mason

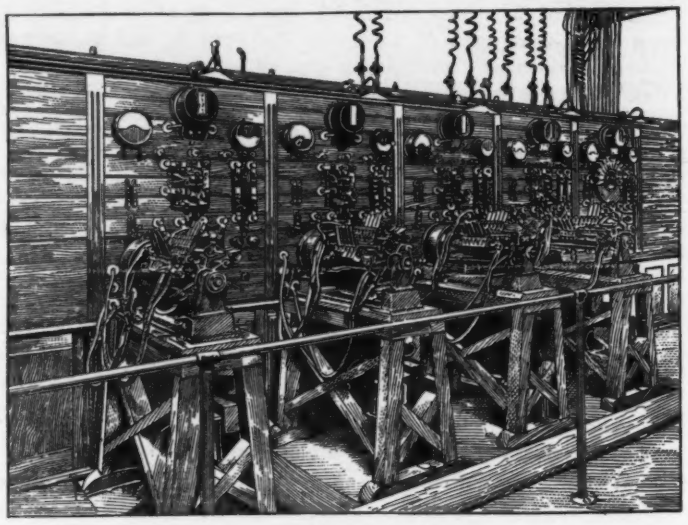


Fig. 2.—Rectifier Station.

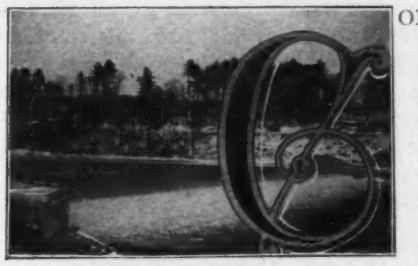
reports, that the system may be fairly claimed to have passed the experimental stage. Their efficiency is stated to be 96 per cent.—that is, the alternating currents are converted into direct ones with a net loss—including the slight reaction of about 2 per cent. on the transformer—of only 4 per cent.

The direct pulsating current thus created are claimed to greatly promote electrolytic action. It also lights arc and incandescent burners, runs continuous-current motors of all sizes down to the smallest, and is used for charging storage batteries, which is the chief function of the Frankfort company. The rectifier and its accessories are exceedingly compact, the whole installation, including seven transformers, occupying only 25 square yards of space, within which compass the apparatus and its capacity might easily be doubled should occasion require. The rectifiers are small, require no other foundation than wooden trestles resting on a solid factory floor, and demand no more oversight than an ordinary dynamo.

English Pessimism.

In the London *Times* a Mr. Furniss makes a number of rather severe statements regarding the "wonderful" electrical inventions. "The working of the telephone has become of course a farce, and the sooner the Government takes it up the better. Several large business houses have given it up, and London, which ought to be the most favored, is probably the most unfortunate city in the working of the telephone of any in the world." The electric light, he says is another disappointing improvement; recently it went out four times in a week, and he had to use candles and lamps; in trying to ring up for a cab on the district messenger wire he received no response, and was therefore late to dinner. "Altogether, it is a question whether paying rental for all these things, and then having, through their failure, to go to greater expense is absolutely advantageous and whether the story of the driver of the old stage coach, who, when railways were introduced, remarked to a passenger: 'Well, all I can say is that if a coach comes to grief—well, there you are; but if there is an accident on the railway, where are you?' might not well be applied to those experiments in the advancement of science intended to facilitate our work and add to our comfort. The electric light kills our sight; the telephone destroys our temper; the district messenger-call ruins our dinner, and, conjointly, they waste our time and deplete our purses." If these improvements are so unsatisfactory, then why does not Mr. Furniss do without them—nobody compels him to use them.

Three-Phase System at Concord, N. H.



CONCORD may almost be said to be the birthplace of three-phase working in America, and it is certain that the success of the power plant installed has done much to encourage the advance of the system.

About seven miles from Concord the Merrimac River has a fall of 22 feet, and produces an average of 5000 hp and a minimum of 4000 hp. This water right is owned by the Concord Land & Water Power Company, and is being utilized for the generation of electric power which is transmitted to Concord and vicinity.

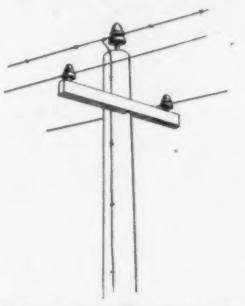
The dam is 22 feet from foundation to crest, and 67 feet from the down-stream to the up-stream pace. It is capable of safely withstanding a sheet of water 10 feet in thickness, but the normal flow is only about two feet. The top of the dam is protected, by a curved steel fender, from the attacks of ice and logs. About 500,000 feet of Georgia pine and 20,000 cubic yards of gravel were used in the construction of the dam itself, while in the abutments and head gates 5000 cubic yards of granite were required. The head gates are five in number, and 10 by 12 feet in linear dimensions. They control the supply to a canal about 1000 feet long, 75 feet wide, and 12 feet deep. Proceeding through a race to the forebay, the water supplies five 8½-foot penstocks.

Each penstock is designed to supply a pair of turbines. There are at present four pairs which deliver 200 hp at 150 revolutions per minute. The turbines were specially designed and were made by the Rodney Hunt Company, of Orange, N. J. The Replogle governor controls the speed within one per cent. under ordinary conditions. The wheel-pits are, of course, below the water-line, and are incased in a solid masonry rectangle. In the recent floods the water-line below the dam has been dangerously near the top of this masonry. Owing to the incomplete state of their waterways, which were not pushed to completion as rapidly as originally intended, the company suffered some by the freshets. It has now been determined, however, to improve the walls and masonry to such an extent as to preclude all chance of future damage from this source, and under the supervision of the company's efficient engineer, Mr. E. F. Carpenter, it cannot fail of speedy accomplishment.

The water-wheels deliver their power by means of belts to a long jack shaft running at 300 revolutions per minute, and provided with pulleys, quills and clutches. The self-oiling bearings of this shaft are of Mr. Carpenter's own design, and have proven remarkably efficient. Hill friction clutches are used. On one section of the shaft is belted an ordinary T. & H. arc lighting plant, with an appropriate switchboard. This plant supplies 300 arc lights in and about Concord.

Interest naturally centres in the two 300-kw three-phase generators, which supply 8000 lights and about 500 horse-power in motors. These machines are driven by belts from the jack shaft and have a speed of 600 revolutions per minute; as they have ten poles, the frequency is 6000 periods a minute. The field magnets of the machine have laminations cast in their pole-pieces and so powerful are they in proportion to the armature reaction, that the regulation is remarkably constant. A single bipolar compound Edison dynamo serves to produce the exciting current for both alternators. The exciting current is approximately 25 amperes at 110 volts. The total weight of the three-phase generators is 18 to 20 tons. The armature of the generator is toothed and carries three sets of coils 120 degrees apart, connected in Y. The coils slip on over the teeth and are secured in place by wooden wedges.

The voltage between any two terminals at full load is 2700. As the centre of the winding is not brought out of the armature, the system is three-wire, and so proceeds to the switchboard. The two machines run in multiple, and have a simple lamp detector to tell when they are in phase. The trouble has been experienced in their pulling out of phase. On leaving the three-pole switch the wires pass through three Whitney alternate-current ammeters, which indicate the station-load. This varies from 80 amperes on each leg at almost 5 p. m. to a minimum of from 15 to 12 amperes early in the morning. The switchboard is supplied with circuit-

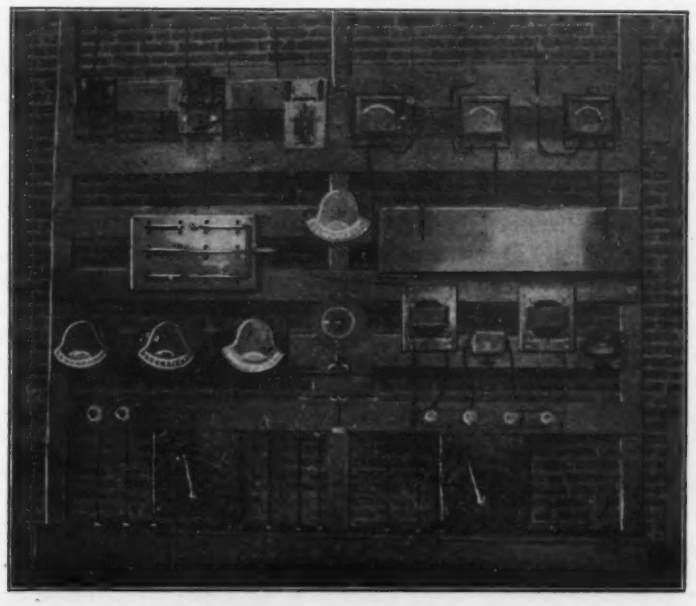


LIGHTNING PROTECTOR.

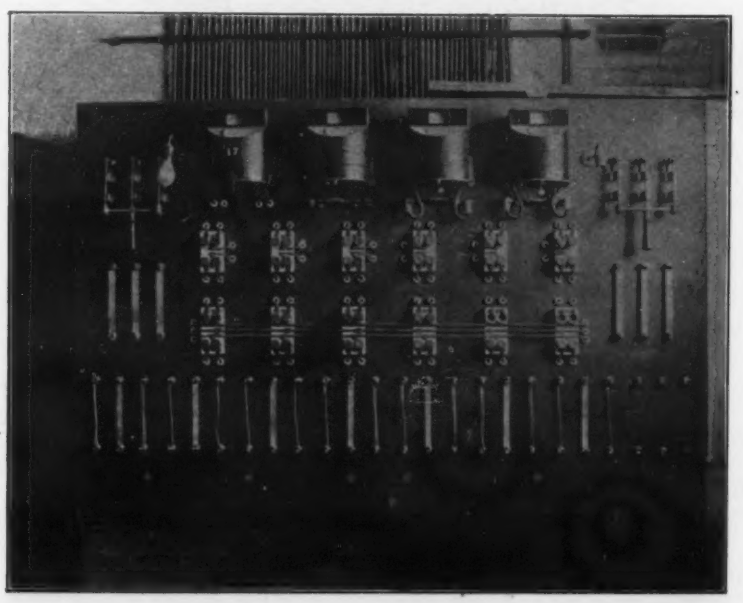
breakers, compensating-transformers for the phase indicated, a rheostat for the exciter, and a voltmeter reading directly the full station-voltage. The long box shown in the engraving by the side of this instrument is the multiplying-resistance, and contains a large amount of well-ventilated fine wires, and is connected in series with the voltmeter.

The station is built low and solidly, after mill construction methods, and especially heavy timbers have been used in its beams and flooring. No provision for heating has been made, for it is found that the gentle warmth of the large machines keeps the room comfortably warm. The windows are all double.

The three-phase wires pass out of the building through porcelain tubes, and make a single span of 475 feet across the Merrimac River. The sag of this span is 25 feet, and to stand the enormous strain silicon bronze wire is used. The ends are tied to seven deep-grooved, double-petticoat glass insulators, placed zigzag on either side of the wire. The tie is nearly seven feet long.



THREE-PHASE SWITCHBOARD.



SWITCHBOARD AT STATE LIBRARY.

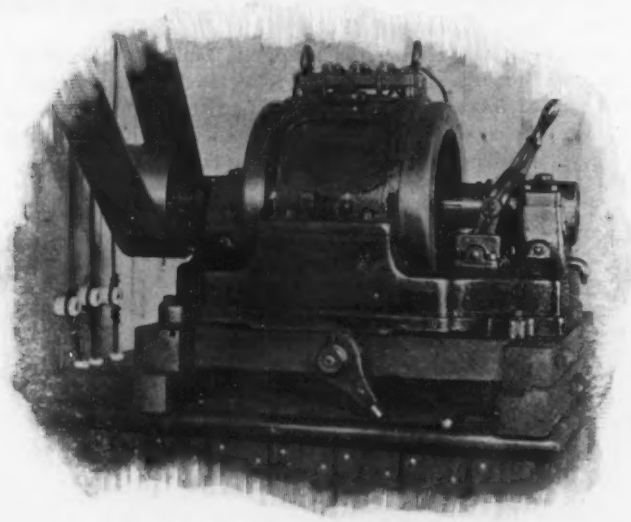
The poles are 40 feet long, and 12 inches in diameter at the top. There are two to each cross-arm, which is formed by bolting an 8 x 8 inch piece of Georgia pine 25 feet long, on either side of the pole. A 6 x 10 inch stick placed flatwise between affords support for the insulators. The poles are securely guyed to heavy anchors. As a protection against lightning an ingenious device designed by Mr. Carpenter is used. On insulators at the top of the poles is strung a barbed wire made of two No. 6 wires twisted together and grounded at suitable intervals. The details are shown in the accompanying sketch.

Proceeding to the city the mains supply a system of feeders so arranged that any section can readily be cut out for repairs. The lighting is balanced between the three transformed mains, and transformers are generally connected in Δ.

The longest line, seven miles, supplies the St. Paul's School with 600 lights. The motors are all induction motors, and they have become very popular among users of power, and can be fairly said to have displaced every other source of power. They require no attention, and, in fact, in many cases are set on a shelf, the switch being conveniently placed below, while the starting lever is manipulated by a long slipper. Thus no floor room is taken up. and the necessity for careful watching is obviated. the motors working very successfully under these conditions. One of the accompanying illustrations shows probably the first induction motor in this country to be practically installed and left in charge of inexperienced hands for active service. The owner expressed himself delighted with it, and stated that it had never given the slightest trouble. At the time it was photographed it had been lying idle for several months without any protection, and exposed to the ravages of dust, dirt and moisture. When current was turned on, it at once started and ran as quietly as though it had been prepared for exhibition.

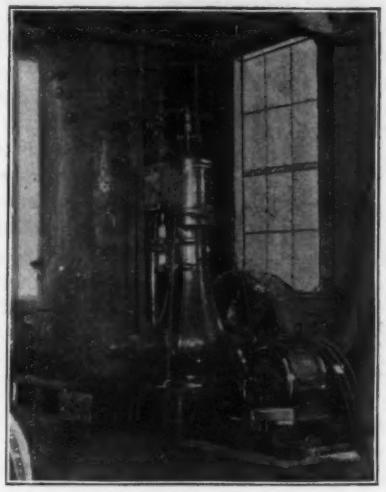
As an example of electricity *versus* steam at Concord, an illustration represents the motive power of the repair shop of the Page Belting Company. A 10-hp boiler and engine stand in the rear, and in the foreground is the 10-hp induction motor that has replaced them. The picture illustrates better than words, and second only to actual experience with the two motors, one of the divers great points of superiority of electricity over its competitor.

Unique among isolated lighting plants, but typical of Concord, is the lighting equipment of the State Library. Its beauty is its simplicity, and so few and simple are the various devices and accessories that the most thorough description must be brief. From a hollow iron pole on the sidewalk the wires descend and enter a conduit, passing to the three-wire switchboard shown in the accompanying engraving. The conduit is large and capacious, and could readily admit of inspection through its entire length.

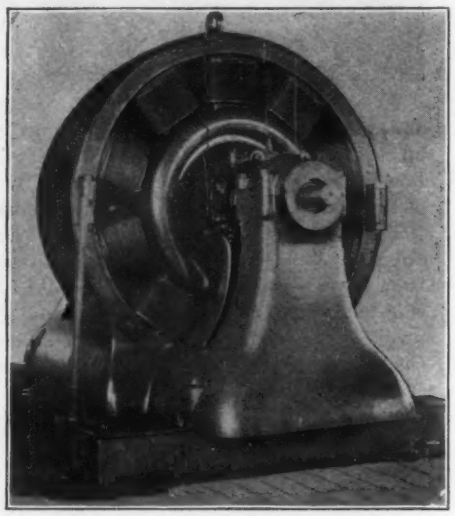


A Pioneer Induction Motor.

The switchboard receives its power from three transformers where bases may just be seen below the lower panels, and which are connected in Δ. Edison three-wire material is used on the board and throughout the building, the exception being that lamps are connected across what with the direct-current system would be 220 volts, as well as from the outside to the middle wire. Careful wireing with regard to balance keeps the load on each leg of the three-wire system the same. It seems quite odd to see this substantial lighting switchboard installed in a room devoid of all noise of machinery save the hum of a three-phase ventilating motor. Interior conduit is used throughout the building. The arrangement of the lights and the design of the fixtures are as much of a delight to the artistically inclined as the electrical equipment is to the engineer.



Steam and Electricity Compared.



One of the Generators.

The Concord Land & Water Power Company possesses a large tract of land near its power station, and it is holding out substantial inducements to manufacturing concerns to locate thereon. In fact, the location of the first industry has already been determined, and buildings are being rapidly pushed to completion.

London Underground Electric Railway.

Mrs. Elizabeth Pennell, in the January number of *Harper's Magazine*, describes the several underground railways of London, and has the following to say of the South London Electric line.

"The trip is made in a quarter of an hour, the road being three miles long, and trains run every three minutes. I believe as yet there are but ten trains in all, but as each makes the round trip in half an hour a larger number could hardly be managed. The journey for the unaccustomed has an element of novelty. You are carried down to the platform and up again to the street level in an elevator. There is no division of classes, and the cars are built somewhat on the model of street cars; three are attached to each engine. I found the light—though it may have been a chance that one day—atrociously bad, the jolting dreadful, and the stations clean and dull compared to those on the ordinary underground. For, of course, there is no smoke, and the tiled walls are immaculately clean; as up and down lines have each a separate tube or tunnel, there is a platform but to one side, and it is made as narrow and contracted as may be; while it is the one place I know where London is as silent as M. Daudet so recently found it. The absence of smoke is an advantage in a way; the atmosphere may savor of the cellar, but there is no danger of being stifled and suffocated by foul air. London being the most conservative place in the world, naturally the electric railway has not yet achieved so great a popularity as to warrant the creation of rivals. The Londoner must have time to make up his mind about it; he is still in that stage of uncertainty when he will pay his penny or two pence to go below and inspect the platform. The wonder really is that this one line happened to be built in the metropolis, which has been most backward in accepting the modern applications of electricity. Do not London streets, except here and there, still wait for the electric light?

"The clearer atmosphere of the electric road is not to be underestimated. Of the drawbacks to the ordinary underground people are agreed that ill ventilation is the most serious. On one of London's murky summer days I would go to much trouble and more expense to escape the plunge into the underground's hot vapor bath."

Central-Station Working—III.

PRACTICAL HINTS.

BY GEORGE T. HANCHETT.

THERE is a class of practical information possessed in a greater or less degree by all station managers which, though held by different managers in various amounts, is yet so widely different that it is always safe to advance "kinks" or "wrinkles" as they are called, for some one will find them valuable. The object of this article is to set forth a few of these items of information, both new and old.

Beginning in the boiler room and, in fact, at the very coal pile, there is an obnoxious "wrinkle" that is practiced by dishonest coal dealers, and even by those who intend to deal fairly. So universal is this practice about to be mentioned that it pays to examine every load that comes to the station with the following point well in mind: Bituminous coal, especially the softer grades, is susceptible to an increase of from 20 to 30 per cent. by judicious wetting, and even then it will not appear suspicious to the casual observer. This moisture is inclined to improve the burning of the coal, but it will be found more economical to apply it after the coal is weighed. The dealer will argue that the coal must be wet in order to shovel it with comfort, but that is no reason why the buyer should pay coal prices for water.

Piping is a part of the station installation in which there is a good deal of opportunity for the station engineer to show his ingenuity.

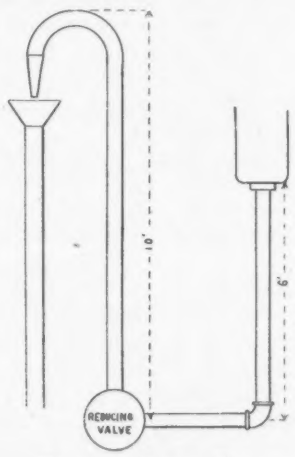


FIG. 1.—STEAM TRAP.

Among the many devices a particularly ingenious one is a simple system of piping to serve as a steam trap. It would be unjust to describe this without giving the credit to whom it is due—Mr. L. J. Hirt, of the New York Metropolitan Street Railway Company. The device is intended to drain away all condensation from separators or other pockets in the pipes that sustain a pressure. Taking the case of a separator shown in Fig. 1, a pipe is led downward a distance of five feet and then turns, rising directly upward to a distance of ten feet, finally turning down and draining into a waste, as shown. At the lower bend a reducing valve is placed which reduces from the boiler pressure to four pounds. When the separator and its drain are empty, the column of water in the low-pressure side exerts a pressure of four pounds to the square inch, counterbalances the pressure of the steam and the reducing valve remains closed. If, however, the water accumulates in the separator, a column of water is formed that exerts an added pressure on the reducing valve, which then opens and blows out the condensation until equilibrium is restored. Thus the separator is continually kept empty. The action of this trap is admirable, and once installed it needs no further attention.

Among the difficulties connected with a large steam unit, there is none so aggravating as a bearing or box that continually pounds. It must be taken up very carefully and by small increments, otherwise a hot box may result, and on a large bearing this is a very serious matter. The engineer may be at a loss from not knowing how much play is taken up by tightening the screws, for the parts are too heavy to test the play except by starting the engine. A convenient method of obtaining the proper tightness of a large bearing that the writer has employed with great success is as follows: Set the engine on a dead centre, disconnect the eccentric rod and work the valves by hand. Admitting steam alternately to either side of the piston will then push the reciprocating parts back and forth the amount of the play, which can thus be detected with greater facility, and a wrench or key applied till it just disappears. Too often a wrist pin is badly scored by an excessive tightening when the real trouble lay in the crank pin. This method effectively detects the play and permits its removal. It may be asked, when a heavy engine is thrown on a dead centre, is it not a more or less difficult matter to get it off, requiring crowbars or a block and tackle? In an electric central station this is seldom a difficult matter, for the necessary means are very conveniently at hand. By means of a little current from one of the other dynamos, the dynamo attached to the engine in question may be turned over as a motor. A water-resistance may be used to keep down the current if the dynamo that is to be motor-driven is of the constant-potential type. If the machine has copper gauze or similar tangential brushes, care must be taken in starting, for if the machine turns the wrong way the brushes are liable to stub and be ruined. It is best to allow just enough current to pass to overcome the friction of repose, when the plant can readily be turned over by hand. If the machine is an alternator, a direct-current can be passed through its armature and the field magnets energized. If the like poles are opposite, the machine will move the angular distance of one pole-piece. If its unlike poles are opposite, the armature will not move at all, and the field terminals will have to be reversed. One pole may not be sufficient, and if such be the case the current must be again reversed. If care has been used in the first energizing of the magnets, and the exciting current cut off at the proper moment, this second reversal will urge the armature one tooth more in the right direction. If, however, the exciting current is kept on and the armature thus held after it had moved one tooth, it will be a case of sheer luck if the motion does not occur in the reverse direction, and thus all the ground gained be lost. While this explanation might create the impression of complexity in the operation, practically it is a very simple one.

It will be found very convenient to make connections between various parts of the switchboard for such purposes as the above. To facilitate this it is well to have a number of short pieces of flexible cable with the ends stripped and soldered into a circular solid wire. A number of short brass or copper rods should be provided with a hole bored in one end and a set-screw provided to firmly clasp any wire that is inserted in the hole. The other end of the rod should then be shaped to fit in the switch-jaws or other terminal devices on the switchboard. An assortment of variously shaped terminals will be needed to accomplish this. Such devices always exist to some extent in an engineer's tool box, but it is very easy at moderate cost to have the arrangement universal.

In lighting stations, as is well known, it is preferable to run at the expense of a bearing, magnet coil or equally important organ, rather than shut down. Therefore any makeshift which will enable the load to be carried is always desirable. The most frequent sources of trouble are hot boxes, but the general remedies therefor are pretty well known. However, as an ounce of prevention is sometimes worth a pound of cure, the following device may be of service to those who have to deal with self-oiling bearings. A self-oiling bearing is one of the least troublesome things in a power station, but when it once begins to heat, the heated parts are so inaccessible that it cannot readily be checked. The most fruitful source of this trouble is the slipping of the oil rings. They have but one point of contact and are very easily brought to a standstill. The writer has found it convenient to bore two holes tangentially to the shaft through the bearing, as shown in Fig. 2. Through these holes a metal chain may be run, and as it has 180 degrees of contact it is more difficult to stop it. It also brings up a great quantity of oil, especially if the latter be at all viscous. The combination of the chain in the hole forms a miniature chain pump and fairly deluges the bearing. In fact, the only difficulty the writer has found is that it throws oil out of the sight holes, any form of lid being thus inadmissible, but a tightly fitting turned plug required.

In lighting stations having a multiplicity of circuits, it is necessary to close at once any circuits that have been broken by the opening of the safety device. This safety device is occasionally a circuit-breaker, but more often a fuse. If it is the latter, much time is wasted in taking off the covers of fuse boxes and otherwise investigating, to determine which fuse is blown. In order to facilitate the rapid detection of the defective circuit, the following device may be

used to good advantage : A lamp is connected at the fuse terminals, and is therefore short-circuited thereby. When a heavy load or a short circuit comes on the line protected by that fuse, the latter blows and the lamp at once lights up. The detector lamps may be neatly arranged on a board (Fig. 3), and thus the station manager, by one glance, can determine the trouble and the instant of its removal.

In the case of a number of direct-current machines run in multiple, the annoying refusal to build up the voltage on starting can be readily overcome by the following method, even if the dynamo refuses to hold its magnetism after repeated charging. Lift the dynamo brushes and then throw the main switch of the refractory machine, being sure the field switch, if any, is closed. Turn the rheostat full on, and allow the machine to run thus for a few moments. This will magnetize the magnets. Let some one stand at the brushes and let down those on one side only, and hold one on the other side in readiness. Throw open the main switch, and give the signal to the man at the brushes to let down the brush at the other side that he has been holding open. If this is done quickly, the machine will catch its magnet before it has time to demagnetize. Care must be taken not to let the last brush down while the main switch is closed. The writer has successfully caused machines to build in this way when they obstinately refuse to do so by all other methods. Of course, if the machine is not properly connected or has a local defect, this method does not apply, but with a machine in perfect order, the method will seldom fail. As every one has a favorite method for calculating wiring, such an article as this would hardly be complete without adding a rule for this purpose. A convenient one, devised by the writer, is demonstrated as follows :

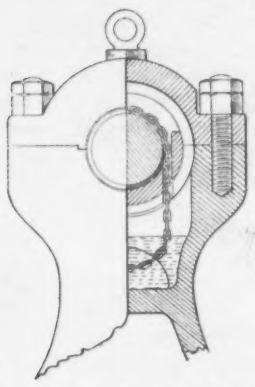


Fig. 2.—Self-Oiling Bearing.

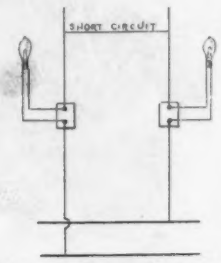


Fig. 3.—Fuse Detector.

Let C = the current each lamp consumes in amperes,
N = number of lamps,
F = the distance in feet one way,
E = line loss in volts,
R = resistance of line,
R_f = resistance of line wire per foot.

Then

$$R = \frac{E}{NC}$$

$$R_f = \frac{R}{2F} = \frac{E}{2FNC}.$$

Most 110-volt lamps working at 16 candle-power take in the neighborhood of one half an ampere, and in the use of new and old lamps one half an ampere is a very fair average. Similarly, one ampere is required for 55-volt lamps.

Then for 110-volt lamps the rule becomes,

$$R_f = \frac{E}{2 \times \tfrac{1}{2} \times F \times N} = \frac{E}{F \times N};$$

and for 55-volt lamps,

$$R_f = \frac{E}{2 \times 1 \times F \times N} = \frac{E}{2 \times F \times N}.$$

Hence for 110-volt lamps, *divide the line loss by the lamp feet, and the result is the resistance in ohms per foot of the proper wire ; and for 55-volt lamps, divide the line loss by twice the lamp feet and obtain a similar result.*

Very Simple.

"Otto, what are those little white caps for, up on the telegraph poles ?"

"Why, that is simple ! They are for the telegrams to get under when it rains."—*Fliegende Blätter.*

Electric Railway Work in the Immediate Future.

In a paper read before the Chicago Electrical Association Dec. 20, Mr. J. R. Cravath outlined some of the new engineering features which he thought would probably enter into electrical railway work in the immediate future. He believes from present appearances that improvements will be in details rather than in great changes as far as roads and the city streets are concerned. The subject of electric-conduit roads is discussed at some length, and the conclusion arrived at that, while the New York Lenox Avenue, and Metropolitan, Washington, roads may prove successful, it is extremely doubtful whether this would be the case on the downtown streets of Chicago, owing to climatic conditions and traffic. The closed-contact system with contact pins on the surface is also considered as of doubtful value, among the objections urged being the difficulty of keeping numerous switch-boxes free of water, the danger of the contact-pins being injured by heavy wagons, and the cost, which is thought to promise little saving over that of the open conduit.

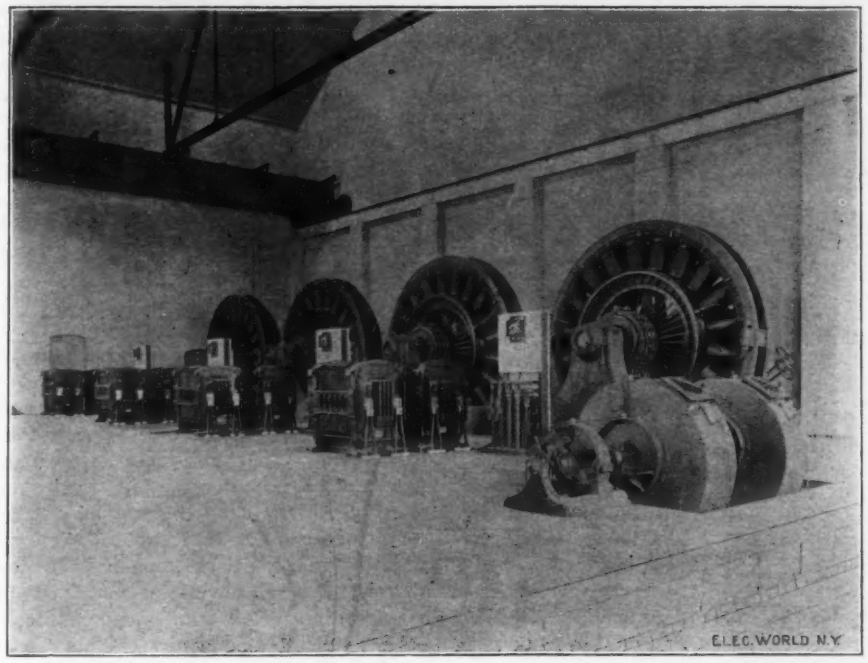
The question of brakes is referred to at some length and the relative advantages of air and electric brakes discussed. The air brake is stated to have the advantage of being easy to apply properly to the trailers and easy to regulate to a nicety. The electric brake is cheap and simple, and does not require skilled labor to repair, but an objection against it is that when operated from a trolley, the car is in a bad predicament if the trolley comes off or the circuit is opened. The electric brake applied by motors acting as dynamos is declared to possess in a special field a bright outlook for the future, but that on elevated and other roads where the number of wheels carrying motors is small in proportion to the number of wheels on a train the advantage begins to disappear and the air brake is declared to have a clean sweep. Another advantage referred to that it is thought will soon be made is the keeping of more accurate records of the drop of voltages in the ground return, and of the voltage of rails with reference to water-pipes and other underground conductors, which he considers to be very desirable in order that the conditions as to electrolysis may become thoroughly understood and that remedies when necessary may be intelligently applied.

It is recommended that motors be regularly tested for insulation, resistance and conductivity, which may easily be done by means of a sensitive voltmeter. The magneto is declared to be out of date and its use is condemned. The adoption of pear-shaped trolley wire similar to that employed on the Nantasket Beach road is advocated.

The use of storage batteries on street cars for motive power is not spoken of encouragingly, but it is predicted that in the future the storage battery will be employed on numerous railways as an auxiliary to generating stations. Mr. Cravath believes that if the electric railway is to cover long stretches through thinly settled, and consequently unprofitable, territory, it will be necessary to adopt higher trolley voltages or abandon the field. The use of alternating currents transmitted at a high pressure and transformed in sub-stations would be impracticable for commercial reasons in the majority of cases. He states that it may be found upon calculation, taking into consideration the present price of machinery and copper, that in order to make it profitable to transmit from a central-station plant to a sub-station 15 miles distant with step up, step down and rotary transformers, the conditions will have to be favorable if the power (including fixed charges) delivered at the sub-station trolley bus is to cost less than if generated by a separate steam plant at the sub-station location. If coal is very cheap ($1.50 a ton or under) and the transmission pressure 10,000 volts, there will be economy in favor of the transmission. With lower voltage and more costly coal the economy begins to disappear and finally appears in favor of the separate steam plant. The advantage in favor of such a transmission is stated to be very slight even under the most favorable conditions, and the investment necessarily greater than for separate steam plants. It is declared evident, this being the case, that unless water-power is available, transmission by the plan outlined does not open up an appreciably greater field for the electric railway than is now open to it. To make an important saving and increase the territory served from the power plant, it will be necessary to strike out the triple transformation of energy, which wastes power and piles up the fixed charges due to heavy investment. The high pressure must be taken direct from the trolley. It is not unreasonable to expect that a direct-current voltage as high as 1000 can be used without serious motor troubles. For longer lines, where higher pressures still are necessary, and where a railway has its own right of way, multiphase motors, which can safely stand several thousand volts, will probably be used.

The Electrical Manufacture of Aluminum.

The output of aluminum has been very largely increased in the United States since the operation of the Pittsburg Reduction Company's plant at Niagara Falls, N. Y. This company is practically the only manufacturer of aluminum in the United States, and controls and uses what is known as the Hall process, the invention of Mr. Charles M. Hall, who is now the vice-president of the company.

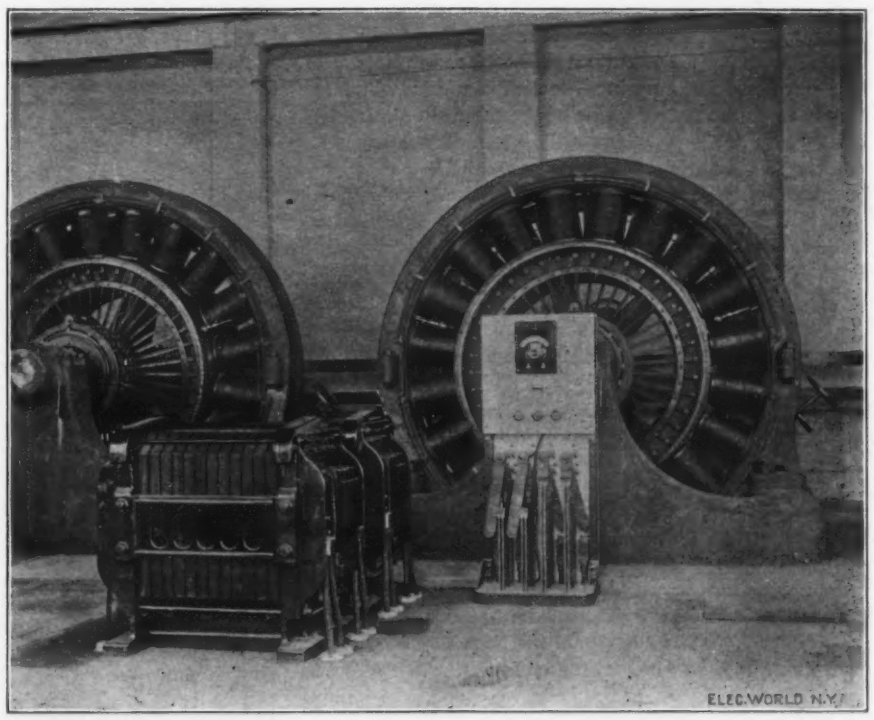


ELECTRICAL PLANT OF THE PITTSBURG REDUCTION COMPANY.

Under this patent the process of manufacture consists in dissolving alumina in a molten bath composed of the fluoride of aluminum and the fluoride of some metal more electro-positive than aluminum. An electric current is passed through the molten mass and aluminum is produced by electrolysis of the dissolved alumina. The fluoride of potassium and the fluoride of calcium with the fluoride of aluminum are the preferable salts used in the molten bath, although the fluoride of aluminum and the fluoride of sodium have been successfully used by the Pittsburg Reduction Company in much of its work. The double fluoride of aluminum and potassium is made by the action of fluorhydric acid upon alumina and pearl ash or carbonate of potassium. The fluoride of calcium is obtained from the mineral fluorspar. When the Pittsburg Reduction Company use the fluoride of sodium, they have in the past largely employed the mineral cryolite as the source of this portion of the salts, although of late improvements have been made by which cheaper methods of producing the double salts of fluorides of aluminum and sodium have been obtained over the use of the comparatively expensive mineral cryolite, which is mined in Greenland.

In the present plant at Niagara Falls, the Pittsburg Reduction Company has two lines of carbon-lined iron pots, arranged in series with the electric current, and it is in these pots that the chemicals are placed. The electric current is passed through the molten mass by the aid of carbon cylinders used as anodes, which extend down into the molten metal. These carbon anodes are attached by copper rods to the main portion of the line conducting the electric current from the positive end of the generating machinery. Thus the pot itself, with its lining and the metal deposited upon the bottom, becomes the negative electrode, or cathode, and the pot is joined by copper connections to the line extending to the positive electrode in each pot. The alumina is deposited by electrolysis in a molten mass at the bottom of the pot by the passage of the electric current through the molten mass. The freed oxygen goes out as carbonic oxide or carbonic acid gas in connection with the carbon of the anode, wearing it away in proportion of a little less than an equal weight of the anode to the aluminum produced. The operation is kept continuous for months at a time, as the wear upon the pots is very slight, the metal being dipped out from the pots each day by heavy cast-iron ladles, replacing the electrolyte on the top of each ladleful of metal with the carbon rods. In some countries the makers of aluminum are greatly troubled with noxious gases, and their employees work only for very short periods. In the Niagara works, however, on account of the special chemical solvents used for dissolving the alumina and the particular strengths of current adopted, there is no trouble in this respect, there being practically no discharge of foreign or other noxious gases into the atmosphere, the only gas evolved being practically carbonic acid. Now and then a carbon will heat above the bath and sputter out in a dark blue flame, showing the burning of carbonic oxide to carbonic acid gas, and indicating the heating power of the current.

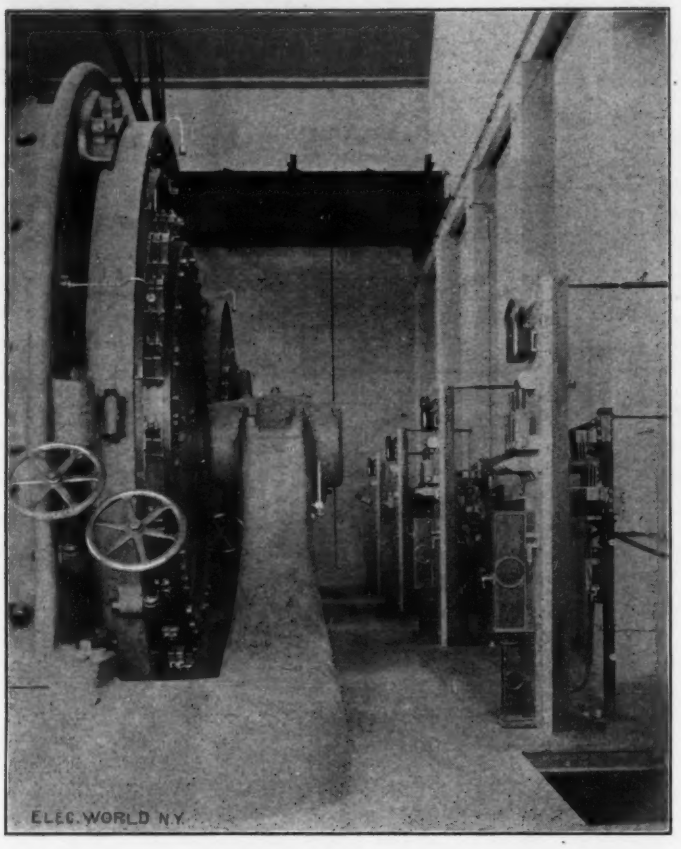
The temperature of the molten bath is kept constant by the passage of the electric current through it, the resistance of the bath generating sufficient heat for this purpose. In the Niagara works, very large currents of low voltage are used, the pressure required being only enough to overcome the electrical resistance of the number of pots arranged in series, each pot now in use requiring from six to eight volts. The electric power used is supplied by the Niagara Falls Power Company from two-phase generators of 2000 volts pressure. It is conducted from the power-house to the factory in copper cables laid in a subway. In the manufacture of aluminum it is necessary that this current should be reduced, as well as transformed from alternating to direct. The static transformers shown in the illustrations reduce the voltage of the current from 2000 to 115, and the rotary converters shown change the current from the two-phase, alternating currents of 115 volts to a direct current of 160 volts. The electrical equipment of the Reduction Company's plant was furnished by the General Electric Company, of Schenectady, N. Y., and is one of the finest in the world. The rotary converter is practically



ROTARY CONVERTERS AND STATIC TRANSFORMER.

a direct-current generator, with proper collecting rings and connections attached to the rear of the armature to lead the alternating-current into the apparatus. Practically, it is a generator and motor combined in one machine. The present electrical plant has a capacity of about 10,000 amperes at 160 volts, or 1600 kilowatts, or about

2000 electrical hp on the direct-current side. The static transformer has an efficiency of about 98 per cent., and the energy transformed into heat is so great that there is not sufficient radiating surface to throw it off; for this reason an air blast is forced continuously



D. C. Side of Rotary Transformer, and Switchboard.

between the coils from below, thus keeping the heat easily under control.

There is a commonly accepted notion that clays are the ores of aluminum. The Pittsburg Reduction Company does not use clays, which are silicates of aluminum, in the manufacture of the metal, but the pure oxide of aluminum, called alumina, which is made from the native oxide of the metal in a mineral called bauxite. This mineral is found in large deposits in Georgia and Alabama, and it is from these States that the supply is secured, which is laid down at the factory in Niagara Falls at a low rate. The composition of this bauxite is as follows :

	Per Cent.
Silica	3.00
Titanic acid	4.00
Oxide of iron	2.00
Water of hydration	32.00
Alumina	59 00
Total	100.00

This ore exists in several peculiar forms, as follows :

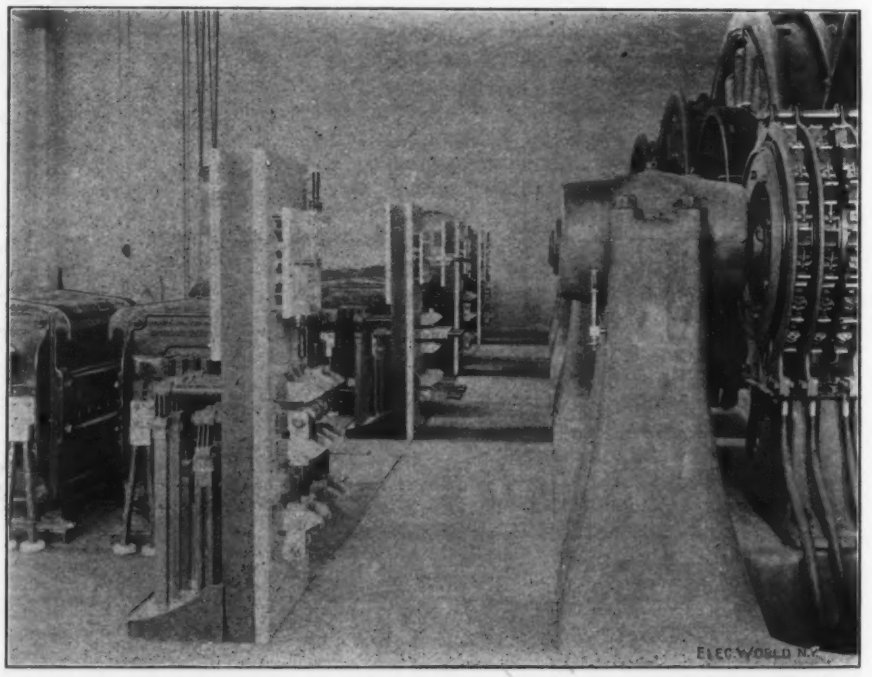
1. In round nodules, or pisolites; some of these being in sizes up to 2 inches in diameter, and each nodule being separated from its fellows. 2. An agglomeration of these nodules into a conglomerate, the binding material between the nodules being pure alumina. 3. A massive formation. 4. A fine powdered condition in the beds at the banks, being mined in the form of plastic mud.

To form aluminate of soda this ore only needs be incinerated lightly with soda ash. This aluminate of soda is dissolved and decanted off and freed from the impurities of silica, oxide of iron, and titanic acid which have not been acted upon, and are insoluble in the hot water used for solution of the aluminate of soda. It is from this solution that alumina is precipitated by passing carbonic acid, formed by the distillation of carbonic acid from limestone, through the solution and also by agitation. The carbonic acid forms carbonate of soda from the aluminate, and precipitates the pure aluminum very freely. This settles at the bottom of the tank, and after being thoroughly washed with hot water and then dried, it is heated for some time at a high red heat to drive off the water of hydration, which makes the ore ready for the production of aluminum by the Hall process, which, as stated, is that used and controlled by the Pittsburg Reduction Company.

So successful has been the Pittsburg Reduction Company's plant at Niagara Falls that though its works there were only started on Aug. 26, 1895, the company has already taken steps to double its capacity and placed orders for the necessary transforming machinery. This increase of capacity will be effected by raising each of the four rotary converters from 400 to 600 kilowatts capacity by rebuilding them, and the installation of an additional rotary converter of 600 kilowatts. The static transformers will likewise be increased and added to. This will give a total of 3000 kilowatts as compared with the 1600 now in use, or nearly double the present capacity. At present about 300 amperes of current are being received on each of the two-phase circuits at about 2200 voltage.

The plant as erected was planned for doubling the capacity in the same buildings, and the contract with the Niagara Falls Power Company is that additional power up to any capacity that is unsold by the latter be supplied when such power be asked for.

The Pittsburg Reduction Company has also contracted with the rival water-power company at Niagara Falls, the Niagara Falls Hydraulic Power & Manufacturing Company, for 4500 electrical horse-power additional. This plant is now progressing rapidly and will be completed in the early Spring. Thus the company is in a position to enlarge its capacity for the use of the Niagara power from both large water-power sources—one using the tunnel, and the other using the hydraulic canal, going through the city of Niagara Falls. This 4500 hp will be used in a factory now in course of construction on the high bank of the gorge ; thus the company will have what will be known as an upper and a lower works, one being on the upper river above the Falls and the other below the cataract. The plant in the new or lower works will consist of dynamos directly attached to the turbine shafts. These generators will be of 750 electrical horse-power each, the turbines to operate them being of 1800 hp each, and furnished by the James Leffel Company, Springfield, O. In this plant the electric current will be transmitted from the power-house at the water's edge in the gorge to the pot room in the factory on the high bank above on aluminum conductors, an innovation, by the way, as copper conductors are generally used. This new plant will be ready for operation next Spring, and it is officially stated that by June 1 the Pittsburg Reduction Company expects to be making 10,000 pounds of aluminum per day at Niagara Falls.



A. C. Side of Rotary Transformer, and Switchboard.

The product of the Niagara plant is now being shipped in ingot

form to the New Kensington Works of the Pittsburg Reduction Company, where its foundries, rolling mills and hammer shops are located, for forming the metal into sheets, bars, plates, tubes, wire and castings. The company does not manufacture any articles of aluminum, as it does not care to become competitors of its own customers.

It is a significant fact of the efficacy of the cheap electric power of Niagara that it is a successful competitor of the Kensington (Pa.) plant. The latter factory is located most favorably in the heart of both the natural gas and cheap coal fuel districts which have made Pennsylvania famous, and though the Pittsburg Reduction Company bought coal delivered at its boilers for 65 cents a ton, it has found its Niagara location more advantageous.

The output of aluminum in the United States in 1885 was 263 pounds, 61,281 pounds in 1890, 850,000 pounds last year, and the output for 1896 is estimated at 3,660,000 pounds. The latest price list of the Pittsburg Reduction Company for aluminum, guaranteed to be 98 per cent. pure, is 55 cents per pound in small lots, 52 cents per pound in 100 pound lots, and 50 cents per pound in ton lots, which price is likely to be reduced next year.

It was in 1885 that the first step toward the manufacture of aluminum for industrial purposes was taken in the United States. This was in the Cowles Electric Smelting & Aluminum Company's works in Cleveland, O., when they began to make aluminum-bronze, which event marks the beginning of the dynamo-electro metallurgy in the United States. It was in 1888 that the Pittsburg Reduction Company began the production of aluminum for commercial purposes by the Hall process.

Resonance in Circuits Possessing Self and Mutual Inductance, Resistance and Capacity.

BY A. S. DUNSTAN.

By way of introducing the subject, a short sketch of the phenomenon of resonance in simple circuits containing self-inductance, resistance and capacity will be given, and the general method of finding the conditions necessary for resonance to occur will be shown.

If an electric circuit containing self-inductance, resistance and capacity has applied to it an E. M. F. which is a simple harmonic function of the time, and therefore may be written

$$e = E \sin pt,$$

and the current in the circuit is given by the well-known equation,

$$i = \frac{E}{\sqrt{R^2 + \left\{ Lp - \frac{1}{Cp} \right\}^2}} \sin (pt - \vartheta). \qquad (1)$$

In this equation i represents the strength of the current, R is the ohmic resistance of the circuit, C its capacity, L its self-inductance, and

$$\vartheta = \tan^{-1} \left\{ \frac{Lp}{R} - \frac{1}{CRp} \right\}$$

Equation (1) shows that the current lags behind the E. M. F. by an angle ϑ, whose tangent is determined by the constants of the circuit, namely, L, C, and R, and by the periodicity of the applied E. M. F. In general the current strength is less than if Ohm's law were obeyed.

Suppose now that in the circuit under consideration the values of L, C and p are such as to satisfy the equation

$$Lp - \frac{1}{Cp} = 0. \qquad (2)$$

We immediately have $\tan \vartheta = 0$, the denominator of equation (1) becomes simply R, and the equation may be written

$$i = \frac{E}{R} \sin pt.$$

This equation shows that in this particular case Ohm's law is obeyed. Furthermore, since $\tan \vartheta$, and consequently ϑ, is equal to zero at any instant, the current and the E. M. F. are in the same phase, the current neither lagging behind nor advancing beyond the phase of the E. M. F. This condition of affairs is known as resonance, and its effect is to increase the strength of the current very much beyond what it would be if the values of L, C and p did not satisfy equation (2).

If L and C are regarded as fixed quantities for a circuit, the existence of resonance will depend upon the value of p, and hence upon the rapidity of alternation of the applied E. M. F. If T is the time required for the harmonic E. M. F. to go through all possible values, we have

$$p = \frac{2\pi}{T}.$$

If now equation (2) is solved for p, and for p is substituted $\frac{2\pi}{T}$, we obtain

$$T = 2\pi \sqrt{LC} \qquad (3)$$

Hence, if T, L and C satisfy (3) resonance will occur, and the current will be a maximum.

The essential condition for resonance is that the current and the E. M. F. must be in phase. Therefore the angle of lag and consequently its tangent must be equal to zero.

In any case in which it is desired to obtain an expression for the conditions under which resonance will occur, it is only necessary to obtain an expression for the angle of lag in terms of the constants of the circuit, and the period of the applied E. M. F., and equate it to zero. Consider now two circuits, each containing self and mutual induction, resistance and capacity. These two circuits will be designated as primary and secondary. The primary will be supposed to have applied to it an E. M. F., which is a simple, harmonic function of the time, while the secondary is supposed to have no applied E. M. F. All currents flowing in it will therefore be due to the inductive action of the primary. It is further supposed that the circuits contain no iron so that the inductances are constant quantities.

Let L denote the coefficient of self-induction, while R and C are respectively the resistance and capacity of the primary circuit, and let N, S, and K denote the same quantities for the secondary. Let M be the coefficient of mutual induction between the two circuits. The currents in the two circuits will be denoted by x and y, respectively, and the E. M. F. applied to the primary will be represented by $A \sin pt$. The energy equations of the two circuits are:

$$L x \frac{dx}{dt} + Rx^2 + \frac{x \int x dt}{C} + Mx \frac{dy}{dt} = Apx \sin pt.$$

$$Ny \frac{dy}{dt} + Sy^2 + \frac{y \int y dt}{K} + My \frac{dx}{dt} = 0.$$

Dividing the first of these by x, the second by y, and differentiating both with regard to t, we obtain:

$$L \frac{d^2x}{dt^2} + R \frac{dx}{dt} + \frac{x}{C} M \frac{d^2y}{dt^2} = Ap \cos pt \qquad (4)$$

$$N \frac{d^2y}{dt^2} + S \frac{dy}{dt} + \frac{y}{K} + M \frac{d^2x}{dt^2} = 0. \qquad (5)$$

Each of these equations contains three variables, x, y and t, but they can be reduced to two, each containing but two variables, viz.: x and t, and y and t, in which form they can be solved. By substituting the value of $\frac{d^2y}{dt^2}$ obtained from (4) in (5), differentiating and substituting again, etc., y and its derivatives may be eliminated from (5). A similar process will eliminate x and its derivatives, from (4) and the two equations will be in the desired form for solution.

The result of this elimination will be two linear differential equations of the fourth order. They may be written

$$\alpha \frac{d^4x}{dt^4} + \beta \frac{d^3x}{dt^3} + \gamma \frac{d^2x}{dt^2} + \delta \frac{dx}{dt} + \varepsilon x = F \sin (pt - \phi) \qquad (6)$$

$$\alpha \frac{d^4y}{dt^4} + \beta \frac{d^3y}{dt^3} + \gamma \frac{d^2y}{dt^2} + \delta \frac{dy}{dt} + \varepsilon y = Ap^3 \cos pt \qquad (7)$$

wherein,

$$\alpha = \frac{NL - M^2}{M} \qquad \beta = \frac{NR + SL}{M} \qquad \gamma = \frac{N}{MC} + \frac{L}{MK} + \frac{SR}{M}$$

$$\delta = \frac{S}{MC} + \frac{R}{KM} \qquad \varepsilon = \frac{1}{CKM}$$

$$F = \left\{ \left(\frac{Ap}{KM} - \frac{NAp^3}{M} \right)^2 + \left(\frac{SAp^2}{M} \right)^2 \right\}^{\frac{1}{2}}, \quad \tan \phi = \frac{1 - KNp^2}{Sp}$$

As this paper is concerned solely with the phenomena of resonance in the primary circuit, only equation (6) will be considered.

To obtain a solution suitable for the purpose in view, assume

$$x = I \sin (pt + \sigma) \qquad (8)$$

wherein I and σ are to be determined. From (8)

$$\frac{dx}{dt} = Ip \cos (pt + \sigma) \quad \frac{d^2x}{dt^2} = -Ip^2 \sin (pt + \sigma)$$

$$\frac{d^3x}{dt^3} = -Ip^3 \cos (pt + \sigma) \quad \frac{d^4x}{dt^4} = -Ip^4 \sin (pt + \sigma)$$

Substituting these values in (6), we have,

$$\alpha Ip^4 \sin (pt + \sigma) - \beta Ip^3 \cos (pt + \sigma) - \gamma Ip^2 \sin (pt + \sigma) + \delta Ip \cos (pt + \sigma) + \varepsilon I \sin (pt + \sigma) = F \sin (pt - \phi) \qquad (9)$$

Equation (9) is true for all values of t, and hence will remain true if t is put equal to $\frac{\phi}{p}$. Doing this we have

$$a I p^4 \sin(\phi+\sigma) - \beta I p^3 \cos(\phi+\sigma) - \gamma I p^2 \sin(\phi+\sigma) + \delta I p \cos(\phi+\sigma) + \varepsilon I \sin(\phi+\sigma) = 0$$

Dividing by $I\cos(\phi+\sigma)$ and solving for $\tan(\phi+\sigma)$ we have

$$\tan(\phi+\sigma) = \frac{\beta p^3 - \delta p}{a p^4 - \gamma p^2 + \varepsilon} \qquad (10)$$

therefore

$$\sigma = \tan^{-1}\frac{\beta p^3 - \delta p}{a p^4 - \gamma p^2 + \varepsilon} - \phi \qquad (11)$$

from which we have

$$\tan\sigma = \frac{\delta p - \beta p^3 + \tan\phi\,(a p^4 - \gamma p^2 + \varepsilon)}{(\delta p - \beta p^3)\tan\phi - (a p^4 - \gamma p^2 + \varepsilon)} \qquad (12)$$

It was pointed out in the first part of this paper that the condition determining the occurrence of resonance was that the angle of lag, and consequently its tangent, must be equal to zero. We therefore put $\tan\sigma = 0$ and get as the necessary relation between p and the constants of the circuit, for resonance to take place.

$$\delta p - \beta p^3 + \tan\phi\,(a p^4 - \gamma p^2 + \varepsilon) = 0$$

and finally substituting for $\tan\phi$ its value, $\frac{1 - KNp^2}{Sp}$ we have

$$S\delta p^2 - S\beta p^4 + (1 - KNp^2)(a p^4 - \gamma p^2 + E) = 0 \qquad (13)$$

whenever the circuit is acted upon by a harmonic E. M. F., whose frequency is such as to make p satisfy (13), there will be resonance, and the current flow will be a maximum.

Equation (13) could be solved for p, and thus an expression could be obtained for the value of p in the general case. Owing to the very complicated form such a solution would assume, it would not prove useful. It will thus be better to examine a few special cases.

The first case that will be considered is that of a secondary negligible resistance, but possessing capacity and inductance. For this case $\delta = 0$ and equation (13) assumes the form

$$a p^4 - \gamma p^2 + \varepsilon = 0$$

solving for p we obtain

$$p = \sqrt{\frac{\gamma}{2a} + \frac{1}{2a}\sqrt{\gamma^2 - 4a\varepsilon}} \quad \text{or} \quad \sqrt{\frac{\gamma}{2a} - \frac{1}{2a}\sqrt{\gamma^2 - 4a\varepsilon}}$$

substituting for a, γ and ε, their values in terms of the constants of the circuit, as already given, and for one value of p, $\frac{2\pi}{T}$, and for the other, $\frac{2\pi}{T_2}$, we obtain,

$$T = \frac{2\pi}{\sqrt{\frac{KN+CL}{2KC(NL-M^2)} + \frac{M}{2(NL-M^2)}\sqrt{\left(\frac{N}{MC} - \frac{L}{MK}\right)^2 + \frac{4}{CK}}}} \qquad (14)$$

$$T_2 = \frac{2\pi}{\sqrt{\frac{KN+CL}{2KC(NL-M^2)} - \frac{M}{2(NL-M)}\sqrt{\left(\frac{N}{MC} - \frac{L}{MK}\right)^2 + \frac{4}{CK}}}} \qquad (15)$$

Equations (14) and (15) show that there are *two* frequencies which can cause resonance. In other words, there are E. M. Fs. of *two* periods which, applied to the circuit under consideration, will give maximum currents, the periods of the two E. M. Fs. being given by (14) and (15).

The second case to be considered is that in which the secondary is of very low resistance and does not contain condensers.

In this case $\delta = o$ and $K = \infty$.

Equation (13) now becomes

$$p = \sqrt{\frac{N}{C(NL-M^2)}},$$

and substituting for p, $\frac{2\pi}{T}$ we obtain

$$T = 2\pi\sqrt{\frac{C(NL-M^2)}{N}}. \qquad (16)$$

Equation (16) shows that under the circumstances considered there is only one period which would cause resonance, and also that the effect of the presence of the secondary is to diminish the value of T. Consequently resonance will occur for an E. M. F. of shorter period than it would if there was no secondary. This is easily seen, if we remove the secondary, thus making $M = 0$, for T then takes the value $2\pi\sqrt{LC}$ and T from (16) is less than this value.

Finally consider the case in which the two circuits are alike in all respects and have no resistance.

For this case

$$R = S = o \qquad K = C \qquad L = N.$$

Substituting these values in (13) we obtain

$$p = \frac{1}{\sqrt{C(L \pm M)}}.$$

Putting one value of p equal to $\frac{2\pi}{T_1}$ and the other equal to $\frac{2\pi}{T_2}$ we have

$$T_1 = 2\pi\sqrt{C(L+M)} \qquad T_2 = 2\pi\sqrt{C(L-M)}.$$

Since resonance occurs only when the period of the applied E. M. F. is equal to the period of the natural vibration of the system, inferences may be drawn from the results given above as to the effect of inductance-capacity upon the free period of a system. Thus the presence of a secondary containing inductance and capacity has the same effect as if the primary had two free periods, and the presence of a secondary containing inductance but no capacity has the effect of shortening the period of free vibration of the primary, by an amount depending upon the mutual induction of the two circuits, and the self-induction of the secondary.

Fly-Wheel Accidents.

The recent fly-wheel accidents, although of the utmost importance to street railway and electric light companies, seem to have attracted very little attention. The Hoboken accident has been referred to, as a rule, in a most misleading manner, and the result of the investigation held by the company some time after the accident seems to have been overlooked. The Albany accident appears to have attracted still less attention though coming, as it did, shortly after the other, and being the cause of several deaths it should have been of deep interest to all liable to the same casualty.

The Hoboken accident is laid by the owners to the carelessness of the engineer, and is consequently of little interest since it shows no fault in the design or operation of the plant and machinery.

An inquiry made of the employees in the Albany power-house the day succeeding the accident brought out as answers to some natural questions the statement that there was no apparent electrical trouble and that while the plant was in normal operation under light load an engine was seen to gain speed. The engineer noticed it immediately, closed the throttle, which action of his did not interfere with its increasing speed. Running to the switchboards he cut the dynamo belted to that engine out and turned around just in time to see the wheel flying to pieces. No fuse had melted and the generator remained in circuit until cut out by the engineer. Accepting as true that the throttle was closed in time we can only surmise that the generator belted to the wrecked engine had been driven as a motor by the other generators feeding the same lines. This cause of the accident seems perfectly clear and it is remarkable that there have been no such accidents before.

The plant consisted of two 500-kw generators compounded for a line loss of about 10 per cent., and driven separately by Corliss engines of like capacity. In addition there were several smaller generators, driven in pairs by high-speed engines. Under the severe requirements of railway work, engines are liable to vary considerably in speed. The two 500-kw generators and two of the smaller ones were connected in parallel to the lines, and if one of the engines lost speed from any cause, there was a possibility of the current from the stronger machines sending current backward through the lagging one. This is particularly liable to happen when the load is light, and is a common occurrence, understood by every electrician who has spent much time in a railway power-station.

What is liable to happen in such a case is as follows: The shunt field winding would still keep the field magnetism in the same direction, but, the direction of the current through the armature being reversed, the generator would be driven forward as a motor. The series-winding would then contain a current flowing in an opposite direction to that in the shunt winding, and would consequently tend to weaken the fields of the machine and increase the current flowing through it. Indeed, the influences of the series-winding is usually strong enough to so weaken the fields as to cause enough current to flow through the machine to operate the automatic brake commonly used. This would not necessarily follow, as the immence force exerted would quickly speed the generator and engine attached to it until it would develop a counter E. M. F., with its weakened fields equal to the E. M. F. of the generators driving it. The E. M. F. of the driven machine once lowered it is a matter of some time to get it

back, notwithstanding the increased speed; and the heavy current that would flow until a balance was effected would leave the fields in the same condition as at starting, when it required a very considerable period of time to build up the fields to their normal strength. Sometimes an engine will give way under such an unusual speed as would thus be attained before a balance was reached.

The danger is not so great from small generators as from large ones, and the time taken for a machine to attain its normal voltage when running at full speed is a fair comparison as to its liability to run away. The greater the proportion of series-winding, the greater also the danger. From the instant the current starts to move the reverse way through the armature, it increases in quantity of flow, slowly sometimes on account of the time taken to reduce the magnetism of the fields by reason of their mass and construction, and the higher speed of the engine as its load is entirely removed; this follows because the action of the current in the field-windings is more rapid than the gain in speed of the weighty engine, until the engine after a time gets a start and brings up its speed with a rush, increasing its E. M. F., and at the same time decreasing the current flowing through it.

The element of time in the strengthening or weakening of a large field magnet is so considerable that the writer has frequently seen one 500-kw generator being reversed by its mate driven by the same pulley, and by quickly strengthening its field by a turn of the field rheostat has brought it back to its work as a generator. Were it not for the element of time in changing the strength of the magnets, no physical movement would be quick enough to check an action that is theoretically as instantaneous as the flow of electricity where there is so little self-inductance. It is this element of time in changing the strength of the fields that will cause an engine to run away.

The cure is as simple as the disease. A spring switch, the spring held in place by a compound magnet balanced by a weight, the magnet wound with both the main wire and the field shunt, and also so balanced as to hold the weight while both currents were in the same direction, and to release it when they opposed each other; this could easily be made and would prove effectual. A prop to hold up the weight could be arranged similar to that commonly used to hold up the governor weights on Corliss engines for convenience in starting.

Regulating and Starting Rheostats.

To the Editor of The Electrical World:

SIR: Mr. George L. Colgate's letter, published in your issue of Dec. 21, contains a complete demonstration of my claim in my letter to you, which appeared in your issue of Dec. 14, namely, that the distinction between a "starting rheostat" and "regulating rheostat" was rarely appreciated.

The rheostat under discussion is a 50-hp regulating rheostat, the dimensions of which are 20 inches x 15 inches x 21 inches. In my letter I pointed out that this meant a dissipation of energy of about 20 watts to the square inch, since all the energy must pass through the walls of an imaginary containing cubical body having the dimensions 20 inches by 15 inches x 21 inches; that is, having about 2000 square inches.

Mr. Colgate in replying acknowledges that the apparatus must continuously dissipate 33,777 watts, but reiterates the claim that it will do this satisfactorily. His explanation is that there are seven plates, all contained in the above cubical space, and that each plate has a surface of about 1000 square inches, making about 7000 square inches for radiation and hence a rate of only about 4.7 watts per square inch.

I wonder it has not occurred to Mr. Colgate to carry his idea further and secure 7000 square inches in an apparatus of still smaller dimensions without increasing the surface temperature, by using, say, 70 plates each 10 inches by 10 inches, so that he would still have the 7000 superficial inches he thinks important and make use of plates much closer together while still exposed to the air. In this way he can no doubt get 7000 square inches in a cubic space 10 inches x 10 inches x 10 inches. Following his reasoning he would still have 7000 radiating square inches, and 33,777 watts to continuously dissipate, and hence only 4.7 watts per square inch, and hence, according to him, a reasonable low-surface temperature.

But I claim that any apparatus which has to dissipate from within a space of 20 inches x 21 inches x 15 inches, 33,777 watts continuously in still air, as in practice, will reach a red heat, and I wrote my first letter endeavoring to make the distinction clear between a "starting rheostat" which can take up large amounts of energy by absorption due to the specific capacity for heat of the material employed, and a regulating rheostat which has to depend solely upon radiation and convection to get rid of its energy, since the duty is continuous and hence the capacity of the material for heat cuts no figure except while it is being brought up to full heat.

A regulator must necessarily be of large volume unless it has a blower, or a cooling stream of water, or some such means for carrying off the heat other than by radiation and the slight convection in still air; whereas a starter may be of very small dimensions for a large motor, if it has a large amount of material, such as iron, which absorbs a large amount of energy for a short time, with only a slight increase of surface temperature.

Hoping that Mr. Colgate will agree with me, that we should rate the 20-inch x 21-inch x 15-inch regulating rheostat at 4.7 watts per sq. in.—that is, 2000 x 4.7 = 9400 watts—that is, as a 10-hp regulator instead of a 50-hp regulator, or else that he will demonstrate by test or by some logical argument, that it is of the latter capacity.

H. WARD LEONARD.

HOBOKEN, N. J.

Invention of the Electromagnetic Telegraph.

To the Editor of The Electrical World:

SIR: Please allow me space to reply to an article signed by Edward Lind Morse, in your issue of Dec. 28, 1895, page 699, in which my letter to Prof. Morse of Dec. 30, 1867, is given, followed by Prof. Morse's reply thereto, in which he writes: "I should be glad to have it sent to me, seeing that I am unable to go to Morristown to inspect it, and that it is rather in your way."

Mr. E. L. Morse does not state that my father died in January, 1859; that Prof. Morse was, within that year, notified of this bequest; that Prof. Morse requested us to keep the instruments bequeathed to him until he could find time to examine them, or that no action was taken in regard to them until *over ten years and eleven months* after my father's death, or until Prof. M.'s letter to me of Dec. 31, 1869, when he could not resist the chance to show his smallness by assuming "that it is rather in your way."

Why should the Vails be held longer responsible (without even being thanked therefor) for property which another could claim at any time, and which we could not legally dispose of. The time approaching for the final settlement of Alfred Vail's estate, it became necessary that these relics should go to the legal owner, so my letter of Dec. 30, 1869, was written. If Prof. Morse could not find time in nearly *eleven* years to arrange for the disposition of this bequest, why did he not relinquish his rights thereunder, as requested by me? If he had done so these relics would not have been found after Prof. M.'s death, as I have been informed, in the box in which I packed them for shipment to him, and from which they were rescued only to be consigned to a lumber room in the Western Union Building, 195 Broadway, New York, to be placed, after the frequent and urgent solicitations of the late F. L. Pope (as told me by himself), on the ground floor of that building, from which they were not long ago removed, why or where I know not.

Prof. Morse's letter of Jan. 24, 1870, referred to in the article under reply, was the answer to my second letter, not published by Mr. E. L. Morse, requesting acknowledgment of the receipt of these instruments, and is as follows:

NEW YORK, Jan. 24, 1870.

MY DEAR SIR: Excuse my negligence in not apprising you of the safe delivery of the box of articles left me by your father's will. It reached me in safety, but is not yet opened, owing to a peculiar press of engagements, which have so wholly absorbed my time and attention that I have not been able to devote a moment to examine its contents.

Please give my kind regards to your mother, and to your Uncle George, and believe me,

Truly your friend and servant,

SAMUEL F. B. MORSE.

J. Cummings Vail,
Morristown, N. J.

They were sent to him at once on the receipt of his letter of Dec. 31, 1869, and I was naturally anxious about their safe delivery.

Why did these valuable historical relics lie for nearly eleven years in an old frame house, in a small town without a fire department? Why was not Alfred Vail's memory honored by disposing of them, as requested by him? Why did they lie unnoticed and uncared for, after Prof. Morse received them from the Vails, until Mr. Pope rescued them, and why are they now hidden from public view?

NEW YORK. J. CUMMINGS VAIL.

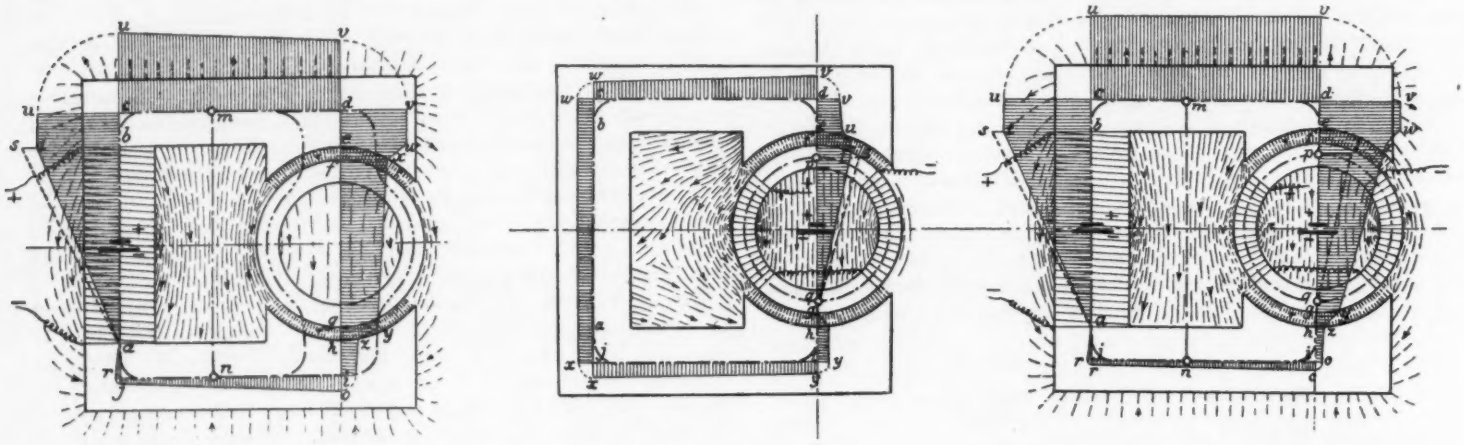
DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

Magnetic Leakage in Dynamos. HANAPPE. *L'Eclairage Elec.*, Dec. 7.—In two previous articles (*Digest*, June 29 and July 27) he describes a method of calculation which he verifies experimentally and finds sufficiently close agreement. The present article refers to the predetermination of the form of the curve showing the variations of the coefficient of the total flux; the article does not admit of being abstracted, but it contains the accompanying interesting illustration showing how the distribution of magnetic potential in the magnetic circuit of a dynamo may be represented graphically. In all three the cross-hatched portion indicates the magneto-motive force, or magnetic potential, the values of which are equal to the distances measured perpendicularly to the centre lines. Fig. 1 refers to a dynamo in which there is no current in the armature; the magneto-motive force is generated in the coil between the points *a* and *b*, the small portion of which



ast representing that which was lost by the reluctance of that portion of the magnetic circuit; there is a gradual loss due to the reluctance of the iron from *b* around to the armature; at the air gap *ef* there is a sudden and large drop of potential represented by *wx* and another smaller one at the other air gap represented by *xy*; the remainder of the magnetic potential is then lost in the reluctance back to the point *a*. Fig. 2 shows the same for the magnetization of the armature-current alone; for simplification only the opposing ampere-turns are considered. Fig. 3 is for a current in both field and armature; there is in that case a counter magneto-motive force produced in the armature and therefore the drop through the armature is much greater; the amount generated in the armature is shown by the small triangle inside of the cross-hatched area over the armature. (The leakage lines of force are not drawn quite correctly, as will readily be seen.)

Induction Motor. BELL. *Cassier's Mag.*, January.—A simple explanation of the principles of the induction motor. He speaks very highly of these motors, stating that in many, if not in most respects, they are preferable to the ordinary continuous-current motor; the complication of these motors is far more apparent than real; when people become more familiar with such motors their genuine simplicity will be better realized.

LIGHTS AND LIGHTING.

The Incandescent Lamp. BAINVILLE. Lond. *Elec. Rev.*, Dec. 27.—The conclusion of the very long serial translated from the French.

Unsolved Problem of the Manufacture of Light. COX. *Jour. Frank. Inst.*, January; a brief extract from a recent lecture.—He states that in the last six years some hints have been obtained for overcoming the difficulties in the direct conversion of energy into light, from the proof of Maxwell and Hertz that light is only an electric radiation; could we produce electric oscillations of sufficient rapidity, the molecules of matter might be discarded and light manufactured without their intervention; oscillations at the rate of 400,000 millions per second would be required; Tesla has produced them in millions per second, and Crookes has shown that by means of high vacua many bodies may be raised to brilliant fluorescence at a small expense of energy.

POWER AND HEAT.

Application of Electric Heating. Lond. *Elec.*; editorial.—According to Borchers, it is best to use the arc in preparing perfectly fused masses of metals and their carbides or silicides having extremely high melting points; but when a considerable mass is to be heated to a high, but not abnormally high, temperature, the resistance method is much to be preferred. Calcium carbide, if made for immediate consumption in the production of acetylene, may be obtained sintered and not actually fused, by the resistance method of heating.

Experimental Electric Furnace. CHARPY. Lond. *Elec. Rev.*, Dec. 27.—A short abstract of an article from a French paper. It was used for hardening steel, and consisted of a small refractory tube 60 cm long and 2.5 cm in diameter, in which the steel was placed; the tube was surrounded by two spirals of platinum wire 7 m long and 5 mm in diameter, surrounded with asbestos and then with two other similar coils, the whole enclosed in a brass tube; a current of 6 amperes at 70 volts was passed through the wires with which a constant temperature of 1200 to 1300 degrees could be maintained in the inner tube, the temperature being easily controlled; to secure uniformity of temperature the apparatus was constantly rotated around its axis by means of a small motor.

Efficiency of Worm Gearing. Lond. *Elec. Rev.*, Dec. 27.—A brief discussion in the *Mechanical World*.

Direct Production of Electric Energy. DUNCAN. *Cassier's Mag.*, January.—By direct production he means the conversion of the energy of fuel into electrical energy without first converting it into heat and without the destruction of chemical reagents or the formation of waste products which require regeneration; as it is apparently impossible to transform any considerable percentage of heat into mechanical or electrical energy it is of the greatest importance to skip this step; he discusses briefly the well-known methods of conversion and points out their limitations. Regarding the subject of direct production, he states that either a gas battery must be used or some substance must be discovered which will in some way convey the oxygen of the air to the carbon without being itself decomposed; results with gas batteries are discouraging; in reference to the use of solid fuel instead of gases he remarks that "We often see in the daily papers that Edison, or some other well-known inventor, has succeeded in solving the problem, but such announcements are never followed by performances." It is not difficult to oxidize the carbon, but the oxygen is usually taken from the electrolyte and not from the air; the use of solid fuel really means the discovery of the proper electrolyte; in a number of methods with which he experimented either the electrolyte or the positive electrode was decomposed, usually both; up to the present time he knows of no publicly described method that fulfills the conditions or gives any promise of success, but he has seen a method, which is not yet patented, which apparently fulfills the conditions and gives currents measured "not in milliamperes, as is usually the case, but in honest amperes and plenty of them." He calls attention to the fact that in central stations the cost of fuel is but a small part of the total running expenses, and a process giving 50 per cent. of the energy of the fuel would therefore be no

such great improvement over the present method, which gives about 10 per cent.; but if we consider the total cost of the energy at the switchboard terminals we see that a simple process of direct conversion would make more than a small percentage difference in the cost; the direct generator would take the place of the boilers, engines and dynamos now in use; if the direct method is comparable to the generation of steam by a boiler, a set of generators one fifth as large as the present boilers would replace the boilers, engines and dynamos and there would be no high temperature, moving parts, or commutators. Taking the expense account of 1000-hp stations, and calculating those for a 200-hp boiler, the comparison, he states, will be surprising and will show what we may expect to obtain; the saving in operating expense and the decreased investment would decrease the total cost of production so much that there would be a great development in electric lighting. For power distribution the same conditions hold, but in competing with an isolated steam plant for power purposes the conditions are changed as a generator and motor would then be substituted for a boiler and engine, but even in this case there is still a marked advantage in favor of electricity, and he concludes that in every case where the steam engine is now used we could substitute with advantage a method of direct generation. His final conclusions are: "1. That the problem, as stated above, will be solved. 2. That the solution will be a simple one. I am, unfortunately, not permitted just now to describe what I believe to be one solution. 3. That it will destroy the boiler and engine industries, and will seriously affect parts of the electrical industry; but it will cause a development in applications of electricity, far-reaching and helpful, in the end, to humanity."

Coalless Cities. CROCKER. *Cassier's Mag.*, January.—He points out the advantages and discusses the feasibility, of using electric power in cities, generated at large central stations, to replace individual steam plants using coal, and he thinks that on electricity alone hangs the only hope of banishing coal and its disagreeable accompaniments from cities; the realization of this hope is not likely to be accomplished in less than 50 or 100 years, but the scheme is perfectly feasible from an engineering standpoint. He assumes a case in which the station is located 10 miles from the city and suggests a plan by means of which it can be carried out; the engines would probably consist of triple or quadruple expansion engines of 20,000 hp; 10,000 volts or more would be required and the total capacity of the plant should be at least 100,000 hp; in the cities the voltages would be 2500; the transformation down to 250 volts should be made in sub-stations, which are very numerous, one in each block, so as to reduce the cost of the low-tension transmission; he believes that the electrical energy could certainly be sold at 2 cents per hp-hour and even allowing double rates for electric lighting, it would cost only 0.3 cent per lamp-hour, which is only half the price of gas at $1.25 per thousand. In conclusion he states that "it is perfectly safe to predict that before the end of the next century, and perhaps in a decade or two, coal will not be brought into some of the big cities of the world, except perhaps in the form of specimens for mineralogical collections."

Gas Engines for Electric Light and Power. PERRY. *Cassier's Mag.*, January.—He points out the well-known advantages of the gas engine, adding, however, that the popular idea that the price of the fuel is controlling in the cost of the power, is a fallacy, for while the cost of the fuel is an important item, it is far less important than other items not usually considered. It is well-known that in a private gas-engine plant more light is obtained by using incandescent lamps than by burning the gas directly, and he therefore asks why electric light companies cannot do the same thing, stating that if the companies use city gas they could supply twice as many lights as when that gas is burned directly. He discusses whether it would pay a company to establish an illuminating gas plant for its own supply, and believes that it would not unless it is done on a large scale; but he thinks it would pay to erect a large gas plant to supply a large number of lighting stations. It is cheaper to transmit gas than electricity at low potential. He discusses the cost of the mains and the cost of the pipes, finding that the latter will be considerably less. The gas plant might also be erected in a more favorable location and the electric stations would then become quite small and could therefore be placed in more advantageous locations. He discusses the production of a cheap grade of gas, which in England is produced at a cost of 1 to 1½ cents per 1000 cb. ft. One ton of anthracite coal will produce from 150,000 to 160,000 cb. ft. of this gas. The standby losses of the gas generated are almost negligible as compared with those for steam boilers.

Water Power and Electric Transmission. EMERY. *Cassier's Mag.*, January.—He discusses the question of when it is advantageous to use water-power and electric transmission; the article includes a large number of illustrations of water-power plants which, however, are not referred to in the text. The general results of his discussion are that "it will be very difficult for electric power, transmitted from a waterfall, to compete with steam power for ordinary manufacturing purposes, in locations where coal is cheap, say less than $3 (12s.) per ton. The contrary is the case where power is required uniformly during 24 hours a day, or in locations where coal is high-priced, whether the plants are operated during working hours, or for longer daily periods." It might be advantageous to establish a water-power and electric transmission for lighting purposes under conditions that would not pay for power purposes.

Electric Pumping Machinery. HAGUE. *Cassier's Mag.*, January.—He discusses the application of electric pumping for city water supplies; economy is gained by using faster-running and more economical engines than can now be used for pumping, and he thinks the saving of fuel, interest and maintenance might more than balance the loss in the transformation of the energy; the economy would be still further increased by furnishing current for other purposes as well from the same plant. He shows the advantages of placing the pumps at their best location in the city and operating them electrically from the main plant; there is a manifest advantage of pumping a comparatively small portion of the total supply against a moderate head for isolated, high-pressure districts, instead of pumping the entire supply of the city against the highest pressure required for the highest levels; while the realization of these plans may be some distance in the future, he confidently believes that many large cities could even now pump the initial supply by means of an electric plant much more economically than at present. In an illustration which he gives he finds there is a saving of over 34 per cent. in power, with a divided service as compared with a single high-pressure plant.

Portland Transmission Plant. LOW. *Jour. of El'ty*, December.—An illustrated description of a number of important features which were not contained in the description recently published in the electrical journals.

TRACTION.

Conduit Railways. LAVEZZARI. *Mem. Soc. Ing. Civ.* October.—A long, well-illustrated paper describing a number of systems in use, including some of the details; among others is the projected system which is to be used in Paris, the right for which was granted last Spring; it is the Holroyd-Smith system, but differs appreciably from that used in Blackpool; the illustration shows a double-track system, beneath which is a large flat-top sewer, whose width is slightly greater than the distance between the two inner rails of the double tracks; in the upper portion of this sewer and directly beneath the tracks, the two conductors, in the form of channel irons, are secured on insulators supported by the covering of the sewer; the feeders are placed in the sewer, being suspended from the top covering; the sewer is large enough to enable workmen to pass through it so that it can be continuously inspected; the rails are not used as a return circuit as there are two conductors; like in the Budapest system, the slotted duct carrying the contact wires is directly beneath one of the rails and not in the middle; the top of the slotted conduit is formed of two rails, like in the Budapest system. It is thought that this will be the most perfect system of its kind and in spite of the great expense due to the sewer, it is thought that the lower cost of maintenance and the better efficiency will compensate for the extra expense.

How to Throw On a Railway Generator. DUBS. Lond. *Elec.*, Dec. 27.—He gives an illustrated description of a special switch for preventing a generator from being thrown into circuit before the equalizer-switch has been closed. The main double-pole switches and the equalizer-switches are connected in the usual way; one voltmeter is permanently connected with the negative bus-bar and the equalizer bus-bar, while another voltmeter for the dynamos to be put in circuit is connected with one pole to the equalizer bus-bar and with the other pole to the other terminals of as many voltmeter-switches as there are dynamos in the station; all the voltmeter-switches have a common movable connection-bar or knife which is put into the voltmeter contacts of the dynamo to be put into circuit; but as the second voltmeter-circuit is then not yet closed, the operator, in order to take any readings of the instrument, has to close the equalizer-switch of the new dynamo; by this simple device there is little chance of forgetting to close the equalizer-switch before putting the generator into circuit by means of the main switch; as there is only one of these connecting-bars it also prevents the short-circuiting of the generators through the switches, which are generally very dangerous when of the double-pole type.

High-Speed Traction. MAXIM. *Cassier's Mag.*, January.—He discusses the subject of electricity for propelling railroad trains at very high speeds; he thinks that engineers have come to the end of their tether in improving the present steam locomotive, and that there is very little room for improvement unless some radically new means of propulsion can be devised; the only way of accomplishing higher speeds on a large scale is by means of electricity; the trouble of making an electric motor that will work well at both very low and very high speeds may be surmounted by using a considerable number of motors on this same locomotive, so arranged that they may be coupled in different ways. By using large stationary engines the cost of developing a given horse-power is 60 per cent. less than with locomotives; power would therefore be cheaper and the traveling load very much lighter. He sees no reason why we might not expect to double the speed of steam-driven trains, the ordinary electric trains traveling at 100 miles an hour and the express trains at 120; to avoid trouble at sidings and switches at a large station steam locomotives might be used for local purposes, like the present switch-engines, electricity being used only for the high-speed work. He believes that everything which he here suggests can be accomplished without doubt with apparatus which is already available, and is to some extent in use.

Electric Railway Work. CRAVATH. *Elec. Rev.*, Jan. 8; a reprint of the first part of the paper on "What Next in Electric Railway Work."—He gives an outline of some of the new engineering features that will proba-

bly enter into electrical railway work in the near future. Regarding conduit roads, he states that there are two requirements, they must be successful from an engineering standpoint and profitable from a commercial standpoint, but there are so few places where the two requirements are met, that no great development is to be looked for; an open conduit road would not be very successful in Chicago or many other cities where the conditions are similar, referring chiefly to drainage; he thinks there is a future for the closed-conduit system. He discusses at some length the subject of brakes, on which he lays great stress, favoring the system in which the braking current is derived from the motors acting as dynamos as in that system there can be no skidding.

An Electric Railway Without a Power-House. Eng. News, Jan. 2.—A road is being considered by the Marquette Iron Range R. R. Co., Mich., for transporting ores; the length is 15 miles, in which there is a fall of about 800 feet from the mines to Lake Superior; on account of the topography an endless chain cable is impracticable; it is therefore proposed to construct an ordinary trolley line without a power-house; the loaded trains come down from the mines generating current, which is to be transmitted to the trolley line and from it to the cars going up grade; the loaded cars weigh 25 tons; each train of 10 or 15 cars will have a motor car; the difference in weight between the light and loaded trains is thought to suffice to overcome the loss of power in the transmission and machinery.

Electric Power on the Illinois Central. Wallace. *Amer. Eng.* January.—Some statements made by him regarding the recent reports that this road is to adopt electric power; he does not think the trolley system will give satisfaction, neither will a third-rail system; the application of electricity will be gradual and slow, and the system adopted must permit of common use of the tracks by steam-power as well; the application of electricity on this road "is still in the air," and while there are indications that it will be made in the near future, it may be two or five years before the question is seriously considered; inside of certain limits electricity seems to be the preferable motive-power for small units at frequent intervals and short distances.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Central Stations for Light, Power and Railways. Kallmann. *Elek. Zeit.*, Dec. 12; reprint of a long paper.—He points out the well-known advantages, from the point of economy, of supplying currents for lighting, power and railway purposes from the same central station. He discusses at some length the chief factors entering into the operation of a central station, and gives some interesting deductions from seven large stations in Europe, six of which belong to the municipalities, all of which use continuous-current three-wire system and accumulators. The average yearly load factor was found to be 6 per cent.; he finds that there is an average of one lamp per meter of house frontage; there is a mean of about 88 lamps for a population of 1000; the average costs per installed kw are about $290 for the generating machinery, and $232 for the distributing system, making a total of $522; on the days on which the consumption was the greatest, the number of lamps in use was 15 per cent. of the total installed lamps, but on the day of the smallest consumption it was 1.5 per cent.; yearly as also daily load diagrams for different portions of the year are given; the average income per kw-hour delivered was about 16 cents; the cost of the coal averaged 1.1 cents per kw-hour; the most economically operating station obtained from 1 kg of coal about 0.5 kw-hours, or about 0.4 useful kw-hour at the consumers; on an average 1 kg of coal gave about 0.4 kw-hours, of which about 25 per cent. was lost in the accumulators and leads, leaving 0.3 at the consumer's end; the average amortization is four to five per cent., which is thought to be sufficiently high; the total cost of a kw-hour delivered is about 14 cents; of the total cost of the current about 40 per cent. is due to maintenance and amortization, about 35 per cent. to interest, and only about 25 per cent. to the cost of operating and management, and of the latter figure only about one third, that is, only about eight per cent. is due to the fuel; he therefore calls special attention to the fact that great reductions in cost are not to be looked for in diminishing the cost of operation, that is, fuel, oil and attendance, but it is in the lessening of the other factors, and this will be accomplished by a better utilization of the capital invested in the plant; he then shows the advantages of supplying the power and railway currents from the same station. There are more than 10 central lighting-stations in Germany, although most of them are small, which also furnish current for street railways; for such combined systems he suggests using two dynamos of 275 volts in series; when connected in multiple arc they may then be used for three-wire lighting circuits, the neutral of which is connected to the battery; the same machines can then be used for railway and for lighting currents; but whatever system is used, a direct-current station is better adapted for this combined service than an alternating-current station; the utilization of the machinery he finds is 11.4 per cent. when used for light alone; 17 per cent. when used for light and power, and 23 per cent. for light, power and railways. The last portion of his paper is chiefly of local interest.

Three-Phase Installation at Schoenenwerd. Preller. Lond. *Engineering*, Dec. 27.—An illustrated description of a 200-hp water-power, three-phase installation in Switzerland, for the largest shoe factory in Europe, the power being used largely for motor purposes.

WIRES, WIRING AND CONDUITS.

Municipal Lighting from Underground Mains. Houston and Kennelly. *Cassier's Mag.*, January.—A long, profusely-illustrated article giving a popular description of underground mains in large American cities (but not limited to what is generally known as municipal plants). They divided them into subway, conduit and the buried tube or conductor system. The estimated length of ducts at present used in America is nearly 6000 miles. The total length of Edison tubes is approximately 200 miles, and the total number of incandescent lamps connected with them is a little over 250,000, besides 3190 arc lamps and 10,951 horse-power in motors. A considerable portion of the article is devoted to a description of central stations.

ELECTRO-PHYSICS AND MAGNETISM.

Electrodynamic Rotations Produced by Means of Alternating Currents. Ferraris. Lond. *Elec.*, Dec. 27; translated from the Italian.—A translation of the complete paper read March 18, 1888, describing his classical experiments which were made in the Autumn of 1885. After giving the theory of the rotating field produced by two alternating fields at right angles, he states how these two fields may be produced by a single-alternating current, as, for instance, by using the primary and secondary currents of a transformer; an illustrated description of his experiments is given. He discusses also the relation between the couple producing the rotation, the useful work, the heat generated and the velocities, assuming ideal conditions, and comes to the conclusion that the mechanical energy is a maximum when the mechanical work is equal to the heat developed, and concludes from this that "these calculations and experimental results confirm the evident *à priori* conclusion that an apparatus founded upon this principle cannot be of any commercial importance as a motor." He suggests that the apparatus may be useful for purposes of instruction; he repeated the experiments with an iron drum in place of one of copper, placed inside of two perpendicular fields, and obtained only a very slight rotation; when he used magnets instead of coils the iron core gave better results than the one of copper; he also used a liquid conductor in the form of mercury placed in a beaker and found that it rotated.

Editorially it is stated that this is the first published translation in English of this paper, which is relied upon in England and the Continent as a prior publication of the principles of polyphase induction motors. Tesla's American patents are dated in 1887 and early in 1888, therefore prior to the publication of this paper. In the experiments the maximum available power obtained was 2.7 watts, while a machine of modern construction of the same size would probably develop 500 watts. He tried to find the conditions of maximum output at which the efficiency could not exceed 50 per cent. A similar reasoning to that used by Ferraris "would have strangled the continuous-current electric motor in its infancy, if left to mathematics alone," as the law of Jacobi leads to the same results. It is also thought that the phase difference may not have been as great as was estimated, which might in part account for the small output.

Skin Effect. Maurain. *L'Eclairage Elec.*, Dec. 7; a brief abstract of a paper read before the Soc. Int. des Elec.—Mascart proposed the function, which gives the relation of the resistance for an alternating current, and the resistance for a continuous current, in connection with the diameter of the wire. On applying these formulas it was found that if the frequency does not exceed 49 it is not necessary to use hollow wires if the diameter of the conductor is not greater than 3.9 cm.; when the frequency reaches 900, which corresponds to telephone currents, the limit of the diameter is 0.9 mm. The formulas obtained indicate that the conductivity of the material is multiplied by the magnetic permeability; this explains the relatively high conductivity of iron for high-frequency currents, which has been noticed; Melsens found that by placing in a circuit, through which a condenser was discharged, two wires, one of copper and the other of iron, almost the whole current passed through the iron, which was thereby fused, while the copper wire remained intact.

Electric Oscillations in the Tesla Experiments. Overbeek. *L'Eclairage Elec.*, Dec. 7.—An abstract from the *Wied. Ann.*, Vol. 55, page 623, giving some of the mathematical deductions; it is presumably the same article that was noticed in the *Digest*, Oct. 26, and referred to Nov. 9.

Thermal Phenomena of Discharges in Derived Circuits. Cardani. Lond. *Elec.*, Dec. 27; translated in abstract from *Nuovo Cimento*.—The article is similar in many respects to the one which was abstracted in the *Digest*, Nov. 23.

Dielectric Constants. Silberstein. Lond. *Elec.*, Dec. 27. Abstracted from *Wied. Ann.*—He devolves the law and proves it experimentally, that with two perfect dielectrics which mix perfectly without contraction of volume, the specific inductive capacity of the mixture will be the sum of the products of the volume into the specific inductive capacities divided by the total volume.

Energy Losses in Dielectrics. Eisler. Lond. *Elec. Rev.*, Dec. 27.—An abstract of the article noticed in the *Digest*, July 27.

Vertical Earth-air Currents. Kay. Lond. *Elec.*, Dec. 27; abstract of a physical society paper.—In a recent paper Dr. Schmidt concluded from a mathematical deduction that a part of the magnetic force of the earth must be due to electric currents traversing the earth's surface, and that this current must amount to about 0.1 ampere per sq. km.; the present

writer tested these conclusions by an examination of the line integral of the magnetic force taken around a circuit in the United Kingdom, and concludes that there is not, in that country at least, a vertical current amounting to the above.

Electromagnetic Signaling. Lond. *Elec.*, Dec. 27, editorial.—It is suggested that a practical system might be devised for a sort of electro-magnetic light-house, the receivers on board ship being some electrical equivalent of the human eye; it is thought there will be little difficulty in developing a suitable generating apparatus, but considerable trouble might arise in devising the receiver, but in connection with the latter he calls attention to the coherer devised by Prof. Bose, and described in a paper by him on a new electro-polariscope, reprinted in the same number of that journal; the sensibility and range of this would appear to leave little to be desired.

Magnetization Energy of Artificial and Natural Nickel-Iron. VOGEL. *Zeit. f. Electrochem.*, Dec. 20.—He refers to the experiments of Hopkinson with artificial nickel-iron, and describes the recent researches of Cohen and Leick with 57 specimens of meteor iron; 41 of these retained a more or less strong permanent magnetism, and their coercive force was rather strong, they were therefore similar to steel; of a second group of ten specimens, three retained a little permanent magnetism and the other seven none at all, they therefore acted like iron; a third group of six specimens gave results between the two. The structure and chemical composition seemed to have no appreciable effect provided there was not too much nickel; the assumption that high temperatures were the cause of the abnormal magnetic qualities is not substantiated. It is concluded that when meteoric iron behaves like soft iron one is justified to assume that it was subsequently heated, but the contrary conclusion must not be drawn if the behavior is normal; the conclusions of Cohen do not agree with those of Hopkinson.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrochemical Phenomena. BUCHERER. *Electrochem. Zeit.*, January.—He gives another account of his theory of electrolysis, which in its general features was first published in THE ELECTRICAL WORLD, Feb. 23, 1895. In the introduction he points out that the modern views of electrolysis are due to an erroneous conception of energy changes, in that electrical energy can be derived from chemical energy is explained by bestowing on chemical energy the attributes of electrical energy in the form of charged ions. In the treatment of other energy changes one does not fall into this error; when a sinking weight drives a dynamo, one does not think of explaining the generation of the current by saying the energy of gravitation is electrical in its nature. In order to explain the static charges at the poles of a voltaic cell, which the modern theory explains by the hypothesis of charged ions, Bucherer shows that if in any system the conditions permit the change of one form of energy into another, and if this change be arrested by unconservative forces, then a condition of constraint ensues which has the characteristic of that energy form which would be generated were it not for the unconservative forces. By moving an open-circuit conductor in a magnetic field, for instance, in such a manner that the lines of force are cut, a system is given in which mechanical energy can pass into electric energy and since conservative forces (the resistance of the air gap in the electric circuit) prevent the electric current from passing, we are bound to find a condition of constraint of the nature of electric energy; it is well known that such a conductor shows electrostatic charges when its ends are joined to an electrometer; so also in the galvanic cell; and as little as we think of explaining the charges of the above conductor by saying that the mechanical energy which caused them is of an electric kind, should we attempt to seek for electrical properties in the chemical substances which furnish the energy of the voltaic current. The author passes on to discuss the phenomena which to his mind lie at the bottom of Ostwald's hypothesis of potential differences at the surfaces which separate the solution of an electrolyte from the electrode; they must be due to a change of the vapor tension of metals by static charges in the case of the capillary electrometer. Closely connected with this hypothesis of Ostwald is the hypothesis of an electrolytic solution tension of metals which Bucherer shows to be entirely untenable; it must be replaced by the vapor tension of metals, a real, measurable, physical quantity which for mercury is, for instance, 0.04 mm at 17 degrees C.; the osmotic pressure of charged ions is to be replaced by the partial pressure of the uncombined gaseous elements which must be in the solution. To prove this by the consideration of saturated solutions in their liquid and gaseous phases is the chief point of interest in Bucherer's article. He has proved, to his mind, by an unimpeachable method, that the energy required for electrolyzing a saturated solution of the salt, as $PbCl_2$ for instance, is spent in bringing the metallic lead vapor, which is in the solution, from its partial pressure to the vapor pressure peculiar to lead, and further, the chlorine, which in minute quantities is present in the solution in free conditions, to atmospheric pressure. This same law must hold for dilute solutions; the fact that dilute solutions show an increase of the number of molecules, the author explains by showing that the solvent must enter into combination with the dissolved substance; electrolytic salts sometimes enter into such firm combination with the solvent that it is difficult to separate the same without entire decomposition. We need only think of certain salts which crystallize with water; with some salts the splitting of the original molecule by entering into combination with the solvents is so great that actual decomposition can follow, as with bismuth salts; with others the acid can be separated by diffusion through a membrane, as with $SnCl_2$ and $FeCl_3$; obviously one molecule of iron can furnish three molecules of HCl and one of $Fe(OH)_3$; this is actually the case when we allow $FeCl_3$ to decompose by adding water, and then separate by diffusion. The modern theory explains this increase of molecules by saying the Fe in $FeCl_3$ has taken a positive charge, and the chlorine negative charges, and thus they have become so-called free ions. Bucherer concludes his paper by urging the necessity of abandoning the views held by Planck, Nernst and Ostwald, and by expressing his conviction that the theory developed by him will lead to the discovery of new facts and of new laws.

Ozonizing the Water of the Seine. ANDREOLI. *L'Elec.*, Dec. 21.—He criticises somewhat severely the recent statements of Tyndal, which were noticed in the *Digest*, Dec. 14, claiming that there is nothing new in the Schneller apparatus and that the information given is quite insufficient; he admits that ozone is the most powerful of all oxidizing agents, and that there would be many applications of it if it could be produced cheaply; he asks what the cost of a kg of ozone would be by that process, which is suggested for sterilizing the Seine water, and how many tons of ozone would have to be generated daily to sterilize the millions of liters of water furnished to Paris; also how long the ozonizers would last; such apparatus usually operates well at the beginning, but after an hour the heat of formation of the ozone, added to the heat of the discharge, increases the temperature, and therefore diminishes the amount of ozone, and as the latter is destroyed at 270 degrees C., the efficiency will fall to nearly zero. He urges that all electricians should protest against such assertions regarding the sterilizing of the water of the Seine; until there exist practical forms of ozonizers which will operate continuously, it is useless to consider its application on a large scale, and he believes that those who have experimented in this field will bear him out in this; it is only a question of producing ozone in large quantitities at low cost, and there is no question about the sterilizing and disinfecting action; he quotes Froehlich and Ohlmueller to confirm the latter view; the former had complete success with experiments made with the water at Berlin, and the latter states that ozone acts energetically on the bacterias in water, provided it is not too contaminated with inert organic substances. It would be interesting to know how many grammes of ozone would be required to sterilize 10 cb. m of the Seine water with the Schneller-Tyndal system.

Production of Magnesium. OETTEL. *Zeit. f. Electrochem.* Dec. 20.—Although a large number of proposed processes for the electrolytic production of magnesium have been described, he states that they all are alike in that the metal is not produced in compact masses, but in the form of numerous small spheres which are very difficult to reunite and which result in a great lowering of the efficiency. It appears that the small spheres are coated with an oxide which prevents their union, and he discusses the origin of this oxide. The raw material used is generally carnallite, a double salt magnesium, chlorine and calcium, which forms a cheap bi-product in the manufacture of chloride of calcium; he shows the importance of freeing the raw material from sulphate of magnesium, and the protecting of the molten metal from water vapors; the formation of the oxide can be prevented by the addition of fluor spar, which acts perfectly well and enables the small spheres to be readily united if the mass is stirred. He describes how the raw material must first be treated; it should be fused in a graphite crucible below a red heat until it has stopped boiling, after which a little sawdust, sugar, fluor spar or similar reduction material is added, and the temperature raised; it should be stirred with an arc light carbon; the mass of salt formed is then kept until used in sealed vessels. The electrolytic process is best conducted in a crucible which is at the same time the cathode, but in laboratories it may be done in a porcelain crucible containing a diaphragm of asbestos paper dividing it into two compartments, one containing a cathode of sheet iron and the other an anode of an arc light carbon; three or four accumulators will suffice when the mass is at a red heat, but not too hot; when finished, the electrodes and diaphragm are removed and the mass stirred with the addition of fluor spar, a solid mass of magnesium will then be formed and may be cast without fear of burning if the temperature is not too high; he has, even on a large scale, obtained an efficiency of 90 to 95 per cent., that is 0.41 to 0.43 g instead of 0.45 per ampere-hour.

Diaphragms. OCHS. *Zeit. f. Electrochem.*, Dec. 20.—He discusses the requirements of ideal diaphragms, stating that the perfect accumulator of the future will depend entirely on such a diaphragm. He discusses the diaphragms of extremely thin metals which were supposed to conduct without polarization, but he found that this is not the case, and that they act by virtue of small holes through them; he also showed the existence of polarization with metallic diaphragms 0.0001 mm thick. A diaphragm which permits the passage of discharged ions, but not of the electrolyte or the other ions, has not yet been proposed, but he believes such a one could be made of mercury. Until now all attempts to produce a practical diaphragm have failed, and one must therefore either be satisfied with a good though imperfect one, or to avoid the use of the diaphragm altogether; he intends soon to describe a way to do the latter.

Intermediate Electrodes. Delvalez; an Academy paper, noticed in *L'Ind. Elec.*, Oct. 25, and more briefly in *Zeit. f. Elec.*, Dec. 20.—If a current is passed through a solution of metal containing a metallic plate, the products of electrolysis will be seen on both sides of this plate; he used a brass plate in a mixture of copper and lead acetate; colored rings resembling Nobilis' rings were formed; on the side toward the cathode they were of peroxide of lead and on the other of metal, either copper or lead depending on the current.

Peroxide Electrodes. Bredig. *Zeit. fuer Electrochem.*, Dec. 20; forming part of a serial on progress in scientific electro-chemistry.—He gives a summary of some recent researches of Tower, the chief object of which was to show that peroxide electrodes, as reversible plates, are quantitatively subject to the same thermodynamic laws for calculating the E. M. F., which, according to the researches of Helmholtz, van't Hoff, Nernst, Ostwald and others characterize the other reversible electrodes. The article is chiefly of interest from a theoretical standpoint, but he also gives formulas for obtaining actual results, in connection with one of which he says that it is the first formula ever given for predetermining the E. M. F. of a peroxide double chain; he states that these researches offered another illustration of the application of the osmotic and electrolytic theory of the Volta chain.

Chemical Potential of the Metals. Bancroft. *Phys. Rev.*, January-February.—He considers the relation between single-liquid polarizing cells and the corresponding constant-reversible cells of the Daniell type, and comes to the following conclusions: "1. The potential difference between a metal and an electrolyte is not a function of the concentration of the salt solution nor of the nature of the positive ion except in certain special cases. 2. It is a function of the electrode, of the negative ion and of the solvent. 3. In aqueous solutions the potential difference is the sum of the term due to the electrode and the term due to the negative ion in the normal cases. 4. For most metals in most electrolytes the term due to the negative ion has the same numerical value and the same sign. 5. For mercury it has the same numerical value, but the opposite sign; for platinum, neither the same numerical value nor the same sign."

UNITS, MEASUREMENTS AND INSTRUMENTS.

Two-watt Metre Method for Measuring Three-phase Currents. E. H. *L'Ind. Elec.*, Dec. 25.—He discusses the two-watt metre method for measuring the power taken by three-phase motors. The most reliable method for measuring three-phase currents is to use a wattmeter in each of the three circuits, and to take the sum of the three readings, but to reduce the number of instruments one can use two wattmeters and take the sum of their readings, but it is necessary then to take some precautions when the motor is running without a load or with a small load. Taking the case of the star system of connection, the series coil is connected in one of the main branches and the shunt coil between the outside end of that branch and the outside end of the neighboring one. He gives the formula for the values, and states that the total power is then equal to the sum of the readings of the two wattmeters, they having been first calibrated by means of a continuous current. This sum is, however, an algebraical one, and, as shown by Nobili and others, for small powers corresponding to considerable phase shifting between the current and the voltage, the readings of the two instruments must be subtracted from each other. He shows how the conditions may be represented graphically, from which he points out that if the motor is symmetrical the three indications of the three instruments will be so also. He also shows from the figure that the readings of the two wattmeters are equal only when the phase shifting between the current and the voltage is zero, that is, when the outside circuit has no inductance; that for a motor the difference of the readings will be smaller the greater the power, and it will therefore be quite great for small loads or no load; that the smaller of the two readings reduces to zero when the phase shifting is 60 degrees and when it is greater it becomes negative, which latter is the case which corresponds to a motor running with no load nearly at synchronism. He concludes from this that it is necessary to notice, in the two-watt meter method, the direction of the deviations; this offers no difficulties if the two instruments are simultaneously put into circuit; but if one instrument is placed successively into the two circuits it is preferable to make two measurements of such loads that the readings change sign, then "the direction corresponding to the large load gives readings which are added arithmetically; the direction corresponding to the smallest load gives readings which must be subtracted."

Photometry of Different Colored Lights. Whitman. *Phys. Rev.*, January-February.—He describes a successful, practical application of Rood's "flicker" photometer, a brief description of which was given in the *Digest*, Jan. 4; the original of that article is published in the *Amér. Jour. of Sc.*, September, 1893. For ordinary photometric purposes some arrangement is necessary by which the luminosity can be varied continuously instead of step by step; the method described and illustrated in the present article is one solution of the problem; the results obtained were surprisingly good in ease, rapidity and precision; a well-illustrated description is given. He investigated a number of points to study the practical utility of the apparatus and comes to the following conclusions: "The flicker photometer, used to compare lights of any color, approximates in convenience and accuracy any of the ordinary photometric appliances used with lights of the same color. Different observers whose vision is normal obtain like results. Irregularities of the division of the disc or the rate of rotation are without appreciable effect on the precision of the measurements. Differences in the absolute brightness of the lights compared present no greater difficulties than in any photometric method. The instrument gives a true measure of luminosity comparable with that obtained in other trustworthy ways."

A New Form of Water Battery. Austin and Thwing. *Phys. Rev.*, January-February.—An illustrated description of a small water battery which they have found very convenient; it is a modification of the type suggested by Rowland and consists of strips of copper and zinc bent into a certain shape and secured perpendicularly to the lower side of a board in such a way that the portions which are to enter the liquid are parallel and close to each other; a small one-drachm homœopathic vial is then slipped over each pair, being held in place by a little shoulder formed of a bend in the plates; the vials have no contact with anything else; the battery is filled by setting it over a pan filled with water which then flows into all the vials, after which it is withdrawn and is then ready for use; the advantage over Rowland's form is that it can be used without re-filling for several weeks.

Rheostats of Loose Graphite. Perrine. *Elec. Rev.*, Jan. 8.—An iron pipe about 2 inches in diameter and 12 inches long is capped on the bottom, is lined with plaster of Paris and is then filled with common loose graphite; the movable terminal consists of a quarter inch iron rod; it has a maximum resistance of about 100 ohms, and is able to absorb continuously, without overheating, between 450 and 500 watts; it has many of the advantages of a water rheostat, is more cleanly and susceptible to less variations; the lining must be thoroughly dried. He considers it the most satisfactory cheap absorber of power which he has used.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Self-Induction in Long-Distance Telephones Lines. Reithoffer. *Bul. Soc. Belge d'Elec.*, July-August-September.—He states that it has often been noticed that speech on long-distance lines is improved very greatly by introducing at one or more points on the line a self-induction, which balances the effects of the capacity on the line. The article is a mathematical discussion of the subject of reducing the capacity by means of self-induction, giving formulas for the calculations.

Telegraphy in London. Wilkins. Lond. *Elec.*, Dec. 27.—A communication in which he refers briefly to the first telegraph office in London for the reception of private messages, which was started in 1847, and which was in his charge.

Telephony in Norway. Bennett. Lond. *Elec.*, Dec. 27.—A short article on the relation of the Government to the telephone; a committee appointed by the Government reported in favor of state acquisition, but the Government has decided to do exactly the reverse.

MISCELLANEOUS.

Dangerous Voltages. Jones. Lond. *Elec.*, Dec. 20.—Experimental data is scanty and conflicting, but the study of reported accidents does not show any very great danger from alternating voltages below 1000; he questions whether alternating currents are more dangerous than continuous; the muscular fixation which plays an important part in accidents is found with continuous currents as well as alternating as soon as the current rises above a few milliamperes.

Therapeutic Effect of Alternating Currents. Aposioli and Berlioz. Lond. *Elec. Rev.*, Dec. 27.—A summary of the conclusions of the article abstracted in the *Digest*, May 11; see also June 22.

Electro-Culture. Flammarion. *L'Ind. Elec.*, Dec. 25; a brief note from an Academy paper.—He endeavored to determine whether a weak current acted on plants; he passed a current equal to that from about three Bunsen cells, through the earth of potted plants, the current entering on one side and leaving at the other, and found that those treated in this way grew more than twice as fast as others equally exposed, but without having a current passed through the earth.

Desirable Improvements. Elec. Rev., Jan. 8.—A reprint from the New York *Herald* of the answers of several prominent electrical engineers to the question as to what inventions or improvements would in their opinion do most to better the conditions of life. Edison replies, the production of electricity direct from coal. Mr. Vreeman says, the immediate and complete reconstruction of the existing horse-car lines in New York City into lines operated by a conduit system. Mr. Cuttriss refers to telegraphy and thinks it will be the placing of underground cables along railway tracks between important business centres, and the perfection of a rapid page-printing telegraphic machine operated like a typewriter. These are under consideration, and their perfection he believes is only a matter of time. Mr. Tesla believes it will be "the demonstration that the earth's electrical charge can be distributed, and thereby electrical waves efficiently transmitted to any distance without the use of cables or wires"; even if power could not be distributed, the mere transmission of intelligible signals would be of incalculable benefit. He is convinced that solutions of these important problems are not far off, and believes that the new year may witness these triumphs.

Treatment for Electric Shocks. D'ARSONVAL. *Elec. Rev.*, Jan. 8.—An abstract of a report as president of the electrical experts appointed by the Paris Academy of Medicine, which report was mentioned in the *Digest*, Feb. 2. He describes the accident at St. Denis and gives brief instructions for treatment according to his method.

Biographical. BENJAMIN. *Cassier's Mag.* January.—An interesting account of some correspondence with Benjamin Franklin with reference to his lightning rod experiments.

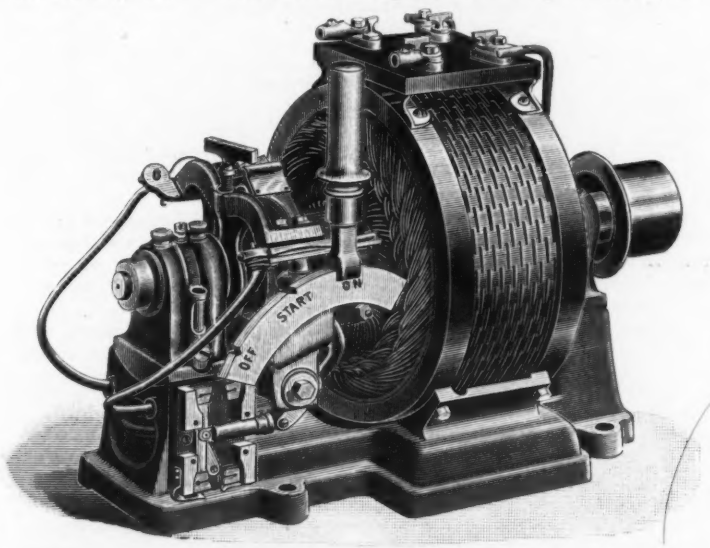
A Large Alternating Generator.

The second direct-coupled 800-kw monocyclic generator built by the General Electric Company has been started successfully in the St. Louis station. This machine and its brother, which has been operating for some time in that station, are the largest generators in the world, so large indeed, that it was impossible to assemble it at the works before shipment. They are now operating successfully incandescent lamps, arc lights and motors in the City of St. Louis.

A New Alternating-Current Motor.

The Emerson Electric Manufacturing Company, St. Louis, Mo., one of the pioneers in the manufacture of alternating-current fan motors, is now introducing a line of small alternating-current power motors, the one-half-hp size of which is illustrated herewith. These motors are non-synchronous, though practically of constant speed, the speed regulation being within 5 per cent. between "no load" and the rated capacity of the motor. They possess nearly all the features of excellence of a direct-current motor, and are superior in having no commutator in circuit (except while starting), and calling for no attendance at the brushes. They are absolutely protected from lightning, from being placed on the secondary side of the circuit, and, being arranged for low voltages, they are protected from the burn-outs due to high potentials and broken wires, which are especially troublesome in 500-volt direct-current motors of small size.

No starting box or other device is required in starting the motor, the



ALTERNATING CURRENT MOTOR.

stopping and starting being effected by a single lever. This lever moves across a sector (shown in the illustration) with three notches marked respectively "Off," "Start" and "On." The lever is allowed to remain in the "Start" notch until the motor has attained its normal speed, when it is pushed to "On." In moving to this latter position the brushes are lifted off the commutator, the external current having no connection with the armature-winding in this position. The switch and fuse terminals are mounted on the motor itself, the only wiring required with these motors being the introduction of the circuit leads into the terminals.

The stock sizes of these motors are made 16,000 and 7200 alternations per minute, and for 104 volts.

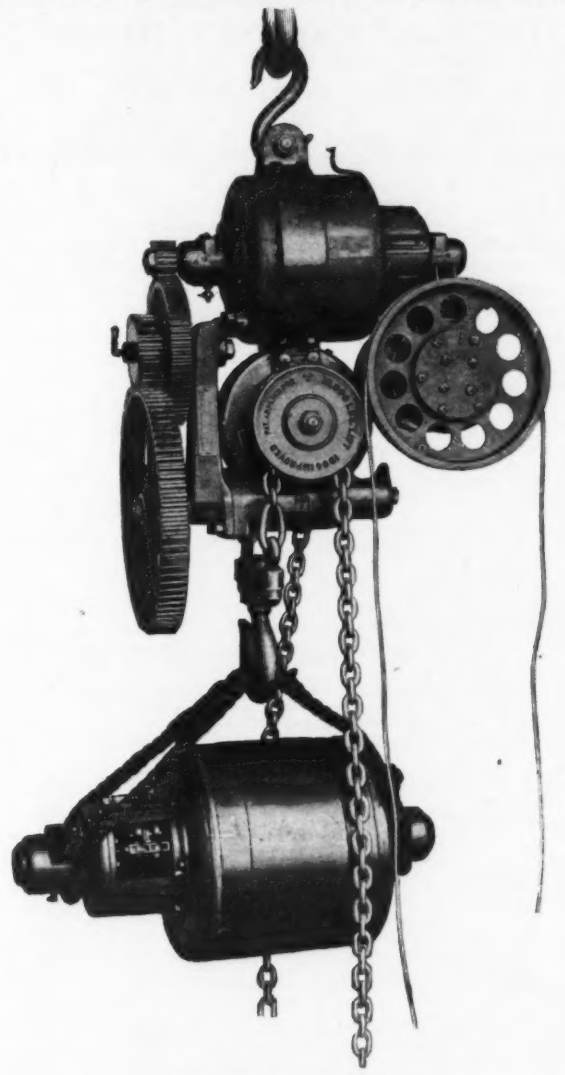
The following are some of the features of merit claimed by the makers, the tests having been obtained with ½-hp motors, and still better results are assured for larger sizes:

A starting torque 50 per cent. in excess of the running torque; a maximum output of 50 per cent. in excess of the rated capacity of the motor; a consumption of energy, running free, of less than 25 per cent. of that under full load; an efficiency of from 65 per cent. to 80 per cent. according to size and frequency; speed regulation within 5 per cent.; a very slight diminution of torque until the speed has fallen more than 25 per cent. below normal, thus enabling the motor to take care of a large temporary overload by virtue of its momentum, and to regain its normal speed afterward, the inability to do which is one of the special disadvantages of synchronizing motors; a power factor at full load, of 67 per cent. on the 130-cycle circuit, and 80 per cent. on a 60-cycle circuit, for a ½-hp machine.

These motors are practically noiseless except while starting. They are provided with self-oiling, self-aligning phosphor-bronze journals and a cast-steel shaft, the oil boxes being arranged with gauges and cocks. The clearance of the armature is a little more than 1-100 of an inch. Sizes are in preparation from ¼ to 3 hp.

An Electric Chain-Hoist.

One of the many moves in the line of direct-connected apparatus is shown in the chain-hoist here illustrated. This piece of machinery, which is especially useful in electric light and power stations, iron and steel foundries, factories, etc., and for handling heavy freight, is made by the Storey Motor & Tool Company, Philadelphia, the type illustrated being of 10,000 pounds capacity. The hoist is operated by a 5-hp motor and will lift 10,000 pounds 5½ feet per minute, and lighter loads proportionately faster.



ELECTRIC CHAIN HOIST.

It will lower at the rate of 10 feet per minute. By means of the reversing controlling box which comprises a part of the apparatus, the hoist will raise and lower anywhere within the above speeds at will of the operator. The starting, stopping, regulating and reversing of the motor is controlled by the two ropes shown in the cut connected to a wheel on the reversing rheostat, which is automatic in its action, the current being cut off as soon as the rope is released.

Niagara Rotary Transformers.

The works of the Pittsburg Reduction Company have now been in operation at Niagara Falls for several months. The necessary electric current has hitherto been furnished through four of the General Electric Company's 400-kw rotary converters, but owing to a considerable increase in the reduction plant they have been found inadequate for the service, and each of these is about to be replaced by one of 600-kw capacity. The new machines will be mounted upon the same base frames as the 400-kw converters, and thus the converter plant will be increased one half without any increase in floor space. A fifth converter of 600-kw capacity will be installed beside the others, and will be similar to them in every respect. The total rotary-converter capacity will then be 3000-kw. Including the transformers installed in the works of the Carborundum Company and the Calcium Carbide Company at Niagara Falls, the General Electric Company will have furnished 5000-kw capacity of transformers for operation in connection with the Cataract Construction Company's system.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Jan. 11, 1896.

EDISON ELECTRIC ILLUMINATING COMPANY OF NEW YORK reports gross earnings for December of $80,638, an increase of $30,378 over December, 1894. The net earnings are placed at $38,422, an increase of $14,418, which, with $9386 income from other sources, makes a surplus of $47,808.

GENERAL ELECTRIC was weaker and inactive around 23 until yesterday, when the common stock went to 26 under a moderate rush of buying orders, which were generally considered to come from inside parties, and to be based upon a knowledge of the result of last year's operations. Friends of the stocks claim that the company made considerable money in 1895 despite the low prices at which its apparatus was sold. Among the low-priced stocks General Electric seems to be something of a favorite just now.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	..	..
" " " Brooklyn	100	110	115
" " " Boston	100	145	150
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	24½	25
Electric Storage, pref	100	25	26
General Electric	100	25	25⅛
General Electric, pref	100	60	63
Westinghouse Consolidated, com	50	30	30½
" " pref	50	54	54½

BONDS.

Edison Electric Ill., New York	105	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	197	198
American District Telegraph	100	33	40
American Telegraph & Cable	100	..	93½
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
Erie Telephone	100	60½	61
Gold & Stock Telegraph	100	105	..
New England Telephone	100	87	88
Postal Telegraph-Cable	100	82	83
Western Union Telegraph	100	83⅜	83¾

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	15¾	16
Binghamton RR. com	100	100	..
Brooklyn Traction	100	5	8
" " pref	100	47	52
Buffalo St. Ry	100	69½	71
Cleveland City Ry	100	69	70
Cleveland Electric Ry	100	59	60¾
Columbus St. Ry	100	45	50
Hestonville	100	50	..
Long Island Traction, all pd	100	16	17
New Orleans Traction	100	15	17
" " pref	100	62	66
North Shore Traction	100	20	30
" " pref	100	75	80
† Philadelphia Traction	50	64	64⅓
Rochester St. Ry	..	25	30
Steinway, Ry	..	50	..
Union Ry. (Huckleberry)	100	112	115
Union Traction, rcts $5 pd	..	10⅜	11
West End, Boston	100	66	66½
" " pref	100	93	..
Worcester Traction	100	14	16
" " pref	100	84	86

BONDS.

Buffalo St. Ry. 1st con. 5s	100	100	103
*Binghamton Railway Co. 5s	100	99	100
Cleveland Elec. Ry. 1st mtge 5s	100	100	103
*Columbus St. Ry. 1st 5s	100	..	100
Rochester St. Ry. 1st 5s	100	102½	104
*Union Ry. 1st mtge 6s	100	105	108
*Westchester Electric 1st mtge 5s	100	98	101

* With accrued interest.
† Ex-Rights.

BUFFALO RAILWAY was the most active traction stock this week; in fact, about the only one that displayed any particular activity. Rumors to the effect that the Mayor would veto the Buffalo Traction 66-year franchise ordinance caused the Buffalo Railway stock to climb rapidly up to 73. Later on, when the fact that the ordinance had been signed became known a decline to 69 occurred. The Traction franchise, as passed, has caused much bad feeling, and Buffalo Railway stock will probably be unsettled until the matter is finally adjusted one way or the other.

BROOKLYN TRACTION.—A small block of stock coming on the market has still further depressed the price of Brooklyn Traction common It has been offered, in consequence, as low as seven. The November report shows a decrease of $10,449 in net earnings, while for the eleven months ending on Nov. 30, the net earnings have decreased $221,363.

NORTH SHORE TRACTION has been very inactive in the New York market since it was listed, some months ago, on the Boston Exchange. The net earnings of the company increased, for the month of November, $4079 over the same month a year ago.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Jan. 13, 1896.

MR. B. E GREEN has severed his connection with the journal *Electricity* which will hereafter be conducted under an entirely new management.

THE SECOND ANNUAL BALL of the associated employees of the electrical firm of Zimdars & Hunt was held on the evening of Dec. 16, at the Central Opera House, and proved to be an absolute success in every respect, more than 400 people being present. The electrical decorations of the hall were particularly attractive. The walls were covered with designs in intricate workmanship and many colors, every mechanical and electrical device in use to date having been utilized in the work, which was all done by the hosts themselves, the employees of Zimdars & Hunt. One of the most novel features was the dancing programme, which appeared on the wall in incandescent electric lights. Each dance in this way was announced, in turn, in luminous characters.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., Jan. 10, 1896.

THE EDISON LIGHT COMPANY, of Fall River, Mass., and the Fall River Electric Company are to consolidate.

MR. J. J. STORROW, leading counsel of the American Bell Telephone Company, is reported to be much broken in health. He is about to leave for the South, to be gone several months.

THE BOSTON ELECTRIC LIGHT COMPANY has been granted permission by the Board of Police to prosecute on Sundays the work of laying its underground wires. This is in response to the objections of over-scrupulous individuals, notwithstanding that it was perfectly plain that Sunday work would avoid serious public inconvenience.

MR. GEORGE THOMPSON, Jr., president of the Thompson-Brown Company, Boston, having entirely recovered from his recent severe illness, is receiving the congratulations of his many friends and pushing business again with his accustomed energy. None can appreciate his return to health more sincerely than his associate, Mr. Maybin W. Brown, who has been taxed to the utmost looking after the increasing business of the company.

PITTSBURG NOTES.

PITTSBURG, Pa., Jan. 11, 1896.

THE SECOND AVENUE TRACTION COMPANY is erecting a new carbarn at Braddock wherein to place the cars of the Braddock division. It will have a capacity of 40 cars, five pits of two-car capacity each.

THE SECOND AVENUE TRACTION COMPANY, of this city, will, it is rumored, during this month, absorb the entire rolling stock and plant of the Duquesne Traction Company, and will at once proceed to remodel the acquired lines at considerable expense.

THE CARNEGIE DIVISION OF THE WEST END TRACTION COMPANY is being extended to Woodvale, some two miles beyond Carnegie, and it is understood that in addition to the 12 cars now on this division, giving a 15 minutes' service, 10 more cars are to be added at an early date.

THE ALLEGHENY TRACTION COMPANY has placed a new 650-hp engine in its power-house. This company has been greatly inconvenienced for lack of power, but with the new engine now being put in place it has one of the best power-equipped roads in this section. The increased traffic of the line has made it necessary to put on a number of new cars.

THE SECOND AVENUE ELECTRIC TRACTION COMPANY has just added a combined sweeper and snow-plow to its equipment at the car-barns of Glenwood, and has now three sweepers at that point. The West End Traction Company has also added a new sweeper and plow for the Carnegie division. This company has recently added to its equipment three of the new No. 38 Westinghouse steel 50-hp motors, and latest style 10 notch controller boxes.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., Jan. 10, 1896.

MR. CHAS. G. ARMSTRONG, electrical architect, Chicago, has just installed in Mr. M. Gottfried's country seat, known as "Villa Gottfried," at

Elkhart Lake, Wis., a 500-light storage-battery plant and a 4-hp launch equipment.

MESSRS. FORSYTH & FISK, switchboard manufacturers of Randolph Street, Chicago, have dissolved partnership, Mr. W. B. Forsyth retires from the electrical field, and we understand Mr. Edward Fisk is on the lookout for some first-class telephone manufacturer to join him in manufacturing switchboards.

TECHNICAL CLUB.—A movement is now on foot to start a club somewhat on the same lines as the Engineers' Club of New York, to be composed of engineers, architects, railway officials and representatives of allied interests. It is proposed to provide all of the usual accommodations of a club, including a restaurant and a rather large number of sleeping rooms. The committee in charge consists of Messrs. C. E. Billin, H. F. J. Porter, A. Sorge, Jr., and B. M. Gardner. There is every prospect from the support already received that the efforts being made will have a successful outcome.

NEW INCORPORATIONS.

THE BLACKSTONE ELECTRIC LIGHT COMPANY, Blackstone, Mass., capital stock, $10,000, has been incorporated to furnish electric light, heat and power. Those interested are Robert B. Taber, Jere Getchell and John J. Getchell.

THE MEADVILLE & SAEGERTOWN STREET RAILWAY COMPANY, Pittsburg, Pa., has been formed by George D. Trawin, H. H. Thompson and F. R. Shryock, Meadville, Pa., for the purpose of building an electric street railway in Meadville. Capital stock, $34,000.

THE PHILADELPHIA & BRISTOL PASSENGER RAILWAY COMPANY, Philadelphia, Pa., has been formed by Henry V. Massey, William V. Massey, Torresdale, Pa.; and F. C. Edwards, Bristol, Pa, for the purpose of building an electric passenger railway. Capital stock, $250,000.

THE SAEGERTOWN & MENANGO STREET RAILWAY COMPANY, Pittsburg, Pa., capital stock, $72,000, has been formed for the purpose of building an electric street railway in Saegertown, Crawford County, Pa. The promoters are George D. Trawin, H. H. Thompson and F R. Shryock, Meadville, Pa.

THE DEGNON CONSTRUCTION COMPANY, Cleveland, O., has been formed for the purpose of constructing electric railways, buildings, water works, docks, bridges, etc. Among those interested are M. J. Degnon, E. W. Radder, W. P. Johnson, William H. Miller and M. H. Holloway. Capital stock, $200,000.

THE NICHOLS ELECTRIC LIGHT & POWER COMPANY, of Nutley, N. J., has been incorporated with a capital stock of $50,000, for the purpose of manufacturing and furnishing electric light and power. The promoters are Thomas Nichols, John Nichols, William Nichols and Richard T. Nichols, Franklin, N. J.

THE ELECTRIC RAILWAY SWITCH & SUPPLY COMPANY, Saco, Me., has been incorporated for the purpose of manufacturing and dealing in electric railway motor and station switches. The promoters are Leonard L. Davis, Edgar V. Tanner, Springfield, Mass., and Ambrose Eastman, Boston, Mass., Capital stock, $100,000.

THE ALPINE MANUFACTURING COMPANY, Philadelphia, Pa., has been incorporated in West Virginia, by Charles D. Cunzer, Camden, N. J., Charles J. Fox, and John C. Patton, Philadelphia, for the purpose of manufacturing and selling machinery, electrical appliances, etc.; capital stock, minimum, $500; maximum, $100,000.

THE WHEELESS ELECTRIC LAMP COMPANY, Alexandria, Va., capital stock, $500,000, has been formed for the purpose of manufacturing and selling the Wheeless lamp and other patents. Those interested are, Phil. B. Thompson, New York City, Goodwin Y. Attel, H. L. Brigan, Malone Wheeless and E. W. Creecy, Washington, D. C.

THE SOUTHWEST MISSOURI LIGHT COMPANY, Kansas City, Mo., capital stock, $300,000, has been formed for the purpose of furnishing electric and gas works and appliances to Joplin, Webb City and neighboring towns. Those interested are Arthur E. Stillwell, E. L. Martin, George M. Myers, and J. McD. Trimble, Kansas City, Mo.

THE COLONIAL CITY TRACTION COMPANY, Kingston, N. Y., has been formed by Charles M. Preston, Kingston, N. Y.; John I. Hathaway and August Belmont, New York; William F. Russell, Saugerties, N. Y., and John C. Kraft, Kingston, N. Y., for the purpose of operating an electric railway in the City of Kingston, N. Y. Capital stock, $195,000.

THE O'BRIEN ELECTRICAL CONSTRUCTION COMPANY, Bloomfield, N. J., capital stock $100,000, has been formed for the purpose of constructing maintaining and operating electric light and power plants and signal and elevator apparatus. Those interested are James P. O'Brien and Philip J. O'Brien, New York City, and Daniel J. O'Keeffe, Bloomfield, N. J.

THE LATROBE & LIGONIER ELECTRIC STREET RAILWAY COMPANY, Latrobe, Pa., has been incorporated with a capital stock of $72,000, for the purpose of building an electric street railway in Westmoreland County, from Latrobe to Ligonier, a distance of 12 miles. Those interested are Edward E. Robbins, John E. Kunkle and Harry N. Yout, Greensburg, Pa.

THE KEYSTONE BOILER WORKS, San Francisco, Cal., has been incorporated with a capital stock of $200,000, for the purpose of dealing in patents, patent rights, manufacturing machinery, constructing cable and electric railways and building bridges. The promoters are James Hamilton, John J. Moore, John V. Hunter, San Francisco, William Leach and James M. Robinson, Oakland, Cal.

THE BAILEY TRIPLE LEDGE GOLD MINING COMPANY, San Diego, Cal., has been formed to construct highways, chutes to and from mines, also railways, to be operated by electricity, steam or other motive power. The promoters are L. H. Bailey, Banner, Cal.; A. G. Nason, O. C. Dranga, San Diego; Dr. E. A. Stanley, Julian, and James A. Jasper, Ramona, Cal. Capital stock, $100,000.

THE CITIZENS' ELECTRIC LIGHT, HEAT & POWER COMPANY, of Trenton, N. J., has been incorporated for the purpose of constructing, owning, operating and maintaining power stations for the manufacture of electricity for light, heat and power. Those interested are Patrick J. Berry, Edward A. Fischer, George Hildebrecht and John M. Burgner, Trenton, N. J. Capital stock, $100,000.

THE SULLIVAN ESTATE COMPANY, San Francisco, Cal., capital stock, $1,000,000, has been incorporated for the purpose of dealing in stocks, constructing electric plants and water works. The incorporators are, Francis J. Sullivan, Charles A. Sullivan, Ada E. Sullivan, Frances V. Sullivan, George B. Sullivan, Henriette Sullivan, Emmet V. Sullivan, Belle S. Turner, Mary Pigott, San Francisco, Cal.

THE ARNOLD ELECTRIC POWER STATION COMPANY, Chicago, Ill., capital stock, $100,000, has been incorporated by Arthur F. McArthur, Bion J. Arnold and Henry W. Magee, for the purpose of acquiring, constructing, equipping and disposing of electric plants, patents and electric railways; manufacturing and disposing of machinery, and doing a general engineering, constructing and contracting business.

General News.

TELEGRAPH AND TELEPHONE.

NASHVILLE, MICH.—Nashville is to have another telephone line in the near future.

MECHANIC FALLS, ME.—The New England Telephone & Telegraph Company is to open an exchange at Mechanic Falls.

LEXINGTON, KY.—The new Interstate Telephone Company is to build an exchange in Lexington. Work will be commenced in March.

NORTHFIELD, VT.—W. E. Nichols is agitating a local telephone exchange to take in the village of Northfield and a radius of about two miles.

ESTHERVILLE, IA.—The Estherville Telephone Company proposes to construct and operate exchanges in Estherville, Emmett County. C. W. Crim, M. K. Whelan, E. J. Breen and F. E. Allen are intended.

MILWAUKEE, WIS.—The National Telephone Company has applied to the Common Council of Milwaukee for a franchise. If a franchise is granted the city will be privileged to use the company's poles and conduits for stringing police and fire alarm wires.

CHATTANOOGA, TENN.—The People's Electric Telephone Company, of Knoxville, Tenn., will erect a telephone line to Chattanooga, Sevierville and Maryville in the early Spring. A local paper says that the long-distance charges will be the same as those of the present Bell Company, and that the Postal Telegraph Company will make the connection with Knoxville by means of the same pole-line.

ELECTRIC LIGHT AND POWER.

MILO, ME.—The people of Milo will probably have an electric light plant.

RIDLEY PARK, PA.—R. S. Pomeroy can give particulars as to the proposed construction of the electric light plant.

DEFIANCE, O.—The citizens will vote on the question of issuing bonds for the purpose of building and maintaining an electric lighting plant

BOWLING GREEN, O.—Bids will be received until Jan. 18, by C. W. Caghan, county auditor, for furnishing a 60-hp engine and 500-light dynamo.

BROOKLYN, N. Y.—The Mutual Gas & Electric Company has renewed its application for a franchise. It was referred to the proper committee.

ABERDEEN, S. D.—The electric light plant has been sold by J. L. W. Zittlow to J. S. Bartholomew, of Grand Forks, owner of the local gas plant. The plant will be greatly improved.

NUTLEY, N. Y.—The Nichols Electric Light & Power Company, recently incorporated, will build a plant for furnishing electric light and power. The capital stock is placed at $50,000.

TOPEKA, KAN.—City Engineer Barnes is working on the specifications for the improvements in the city electric light plant. The specifications will call for 60 new lights and about 10 miles of new wire, three dynamos and the necessary fixtures.

ROCKFORD, ILL.—At the meeting of the City Council the committee on lights will recommend the appropriation of $7,000 for the installation of a municipal electric lighting plant. It will also recommend that $10,000 be appropriated for the sinking of two artesian wells at the new lighting plant.

DES MOINES, IA.—The Council committee of the whole has passed the appropriation ordinance over the Mayor's veto, providing $5000 more for street lighting than last year's ordinance. This will furnish in the neighborhood of 70 additional arc lights. It has been decided to remove from 50 to 100 gasoline lights, to be replaced with arcs.

WEBB CITY, MO.—The Webb City Light & Power Company has probably been merged into a new organization, incorporated as the Southern Light Company. The company at Webb City and the Southwestern Light & Power Company, operating at Grand Falls and lighting Joplin, have been for some time under the supervision of George M. Myers, who is interested in the new concern.

ALAMEDA, CAL.—At the meeting of the municipal trustees, plans and specifications were read for the installation of additional electrical machinery to the city's plant, involving an outlay of some $15,000. It will necessitate the erection of a new building, the placing of a new engine and boilers, and of a new dynamo of a capacity of 4000 incandescent lights. Proposals will be invited at once for the work.

TRENTON, N. J.—Bids were received on Jan. 7 for street lighting on the basis of three and five year contracts. The Citizens' Electric Light, Heat & Power Company offered to supply 250 or more arc lights of 1500 candlepower at the rate of $95.60 for three years or $89 for five years, and 2000

candle-power lights at $107.60 for three years, or $99.60 for five years. The corresponding figures of the People's Light & Power Company of Newark are $91, $90, $99.50, and $99.50, and of the Trenton Light & Power Company, $109.50, $98.55 for 2000 candle-power lamps.

The Electric Railway.

WINCHESTER, MASS.—The selectmen have drawn up a franchise which has been presented to the Mystic Valley Street Railway Company for acceptance.

LOWELL, MASS.—The Wakefield Street Railway Company is now running cars to Lynn, a distance of 29 miles. Connections are also made at Lowell for Nashua.

MANCHESTER, N. H.—The State Railway Commissioners have authorized an increase of $175,000 in the capital stock of the Manchester Street Railway Company.

STURBRIDGE, MASS.—A franchise has been granted to the Southbridge & Sturbridge Electric Street Railway Company for a line from Sandersdale to Fiskdale.

LONG BRANCH, N. J.—The Long Branch Commission has granted the Atlantic Coast Electric Railway Company a franchise to cross Cedar Park, Lincoln and North Lincoln Avenues.

HARTFORD, CONN.—A trolley road is to be built by F E. Wardwell, of Wardwell Brothers, and others from Danbury to Golden's Bridge and the Harlem Railway, a distance of 14 miles.

SUNDERLAND, MASS.—A meeting was recently held in the town hall with a view to raising money to build an electric railway connecting Sunderland, North Amherst and Amherst. The distance is eight miles, and the estimated cost $75,000.

SHREWSBURY, MASS.—At a meeting of the citizens last October, a committee was appointed to organize a company to build an electric railway line from the lower village to Worcester line at Lake Quinsigamond. A meeting of this company has now been called to take definite action.

CITY OF MEXICO, MEX.—The Compania Mexicana De Ferrooarriles Industriales has been granted a concession by the Federal Government to construct and operate several railways and the necessary telegraph or telephone lines for the use of the roads in the Federal District, and the States of Mexico, Hidalgo, Puebla, Morelos and Kicheacan.

TARRYTOWN, N. Y.—The Village Trustees held a meeting to discuss the proposed trolley line through the town. There are three companies after the franchise, two of them outside corporations. The third is the Tarrytown Electric Railway Company, which will probably obtain the franchise. The board will meet again on Jan. 20 to award the franchise.

COHOES, N. Y.—The proposition to extend the Cohoes City Electric Railway to Crescent, a pleasant country town adjoining Cohoes, took definite form at a meeting of citizens held at Scanlan's Hotel. F. A. Pelka, who has been instrumental in getting the railway authorities to consider the matter of extending the road, presided. The extension of the road will cost $16,000.

Trade and Industrial Notes.

THE ELECTRIC & STEAM APPLIANCE COMPANY, Jersey City, N. J., proposes to conduct a general mechanical engineering business, and manufacture and deal in machinery of all kinds, including valves and electrical mechanical controlling devices.

THE CALIFORNIA ELECTRICAL WORKS, San Francisco, have just ordered from the Warren Electric Company, one 45-kw alternator and exciter, wound to 2000 volts at a frequency of 60. The Pueblo Light, Heat & Power Company, of Colorado, has also ordered a dynamo from the above company.

H. E. COLLINS & COMPANY, Pittsburg, Pa., sole sales agents for the Cahall Water Tube Boiler, manufactured by the Aultman & Taylor Machinery Company, Mansfield, O., announce that they have opened a branch office in the Peninsular Bank Building, Detroit, Mich., in charge of Mr. Louis Scofield, who will look after the interests of the Cahall boiler in that district.

THE NATIONAL INDIA RUBBER COMPANY, Bristol, R. I., has secured a very large and important contract for N. I. R. cables and is exceedingly busy in their electrical department. It also has a new catalogue in press, and will send to their many friends and customers a copy as soon as issued. They will also be very glad to furnish a copy to any one who will favor them with their address.

THE WATERTOWN STEAM ENGINE COMPANY, Watertown, N. Y., has just closed a contract to furnish, within 30 days, a 300-hp steam plant, consisting of engines, boilers, pumps, heaters, piping, masonry, etc., complete, erected and running. For every day's delay a penalty of $25 has to be paid, and for every day in advance of the specified time, a premium of the same amount will be earned, which will be doubled for every day more than ten.

THE E. P. GLEASON MANUFACTURING COMPANY, the well-known manufacturers of electric light specialties, corner of Houston and Mercer Streets, New York, is enjoying the best Fall and Winter trade for some years, especially in its glassware for electrical purposes. The company has been compelled to run two forces of men in its glass factory in order to meet the increased demand. The Gleason glass factory in Greenpoint is said to be one of the largest in this country.

MESSRS. J. W. CREGAR AND A. G. LOWE, two enterprising young men, have established a general agent's office at 1111 Betz Building, Philadelphia, and will entertain propositions to represent manufactures of mechanical and electrical machinery or supplies of any kind. They have just beon appointed general sales agents for New Jersey, for the American Eureka Fuel Economizer Company, and also represent the Electrical Maintenance Company of New York City. Messrs. Cregar & Lowe state they have closed contracts for the maintenance of over 60 plants in Philadelphia.

EUGENE MUNSELL & CO., 18 Water Street, New York, report an increased demand for solid sheet India and amber mica, of which they make a specialty for electric insulation. They have recently installed several new power presses, which gives them increased facilities for furnishing stamped solid sheet mica segments for all types of railway motors, and mica to any shape or pattern. Mr. Franklin Brooks, the junior member of the firm, is now making a tour around the world, and, at the present, is spending considerable time at mica mines in India, where the firm is largely interested.

MR. JAMES E. WOODBRIDGE, for many years at the head of the small tool department of the Pratt & Whitney Company, of Hartford, Conn., has recently acquired an interest in, and become identified with the Brady Manufacturing Company, of York and Washington Streets, Brooklyn, N. Y., of which company he is now president. It is now the intention of the Brady Manufacturing Company to take up the manufacture of a full line of small tools of every description, in addition to its regular business of special automatic and labor saving machinery, special tools and fixtures, including complete plants for the manufacture of specialties.

ART IN CATALOGUES.—The General Electric Company send us three catalogue publications gotten up for distribution at the Atlanta Exposition which are high expressions of the engraver's and printer's art. One is a collection of more than 50 half-tones unaccompanied with text, giving extremely well executed half-tone views of all the more recent types of machinery and important installations of the General Electric Company. Another is devoted to the Thomson recording wattmeter, which appliance is illustrated and described in much detail. The third is a 12-page folder giving an account of the connection of the General Electric Company in the development of the various grade electrical industries.

THE MICHIGAN PIPE COMPANY, of Bay City, Mich., is zealously keeping before the public products treated with dead oil of coal tar, such as conduits, lumber, telegraph poles, railway ties and paving blocks, all of which particularly interest electrical engineers. The increase in this branch of its business is shown by the fact that it is consuming the entire output of dead oil from a number of the largest coal gas works in the country. It also enjoys a large business in manufacturing "Improved Wyckoff Water Pipe" and "Steam Pipe Casing," bored from solid pine logs. Its steam pipe casing has a successful history of twenty years as a covering for underground steam pipes of central heating plants, which some electrical companies have recently installed to give a commercial value to their exhaust steam.

SPEAKING-TUBE TELEPHONES.—In the handsomest telephone catalogue that has ever come under our notice, the Metropolitan Telephone & Telegraph Company, of New York, describes various forms of a special telephone supplied by it, called the "speaking-tube" telephone, to distinguish it from the telephones used in talking over considerable distances. As may be inferred, the instrument is intended for interior service, and when there are more than two stations it is used in connection with a small switch at each station, enabling any person at any station to call another station and establish the desired connection without the aid of an operator. One of the modifications is a system whereby secrecy is secured between any two stations, and independent communication also provided between a number of stations at the same time.

THE AMERICAN GAS ENGINE ELECTRIC COMPANY, of 611 Ogden Building, Chicago, have with the close of the year practically completed the largest gas-engine station in America, and a station which among central electric-light stations run by gas-engines is claimed to rank second in size in the world. This plant is supplying six city blocks in Chicago, and has a capacity of about 4000 16-cp incandescent lamps. The gas engine units are 80, 130 and 200 hp, respectively; natural gas is used for fuel, and is being piped 175 miles from the Indiana gas fields. The engines are all double acting, of English make, the American Gas Engine Electric Company being the selling agents for the same. This plant was installed by the company to demonstrate to those interested the practicability of gas-engine power for large gas and electric stations. The results obtained from this plant will soon be published, and the company then expects to command the attention of all users of power, as it claims to be easily shown that these engines surpass any steam engine in economy.

MONOBAR.—In a cloth-bound catalogue the Link-Belt Engineering Company of Philadelphia, Pa., describes the "Monobar," a name given to the principal mechanical element of the apparatus manufactured by this company for conveying and elevating purposes, consisting of a series of bolts flexibly connected with attachments for conveyor flights or elevator buckets. It is claimed that the monobar for conveying and elevating purposes is superior to any chain or equivalent device now in use. Among the advantages claimed are that there are no welds, which is the chief element of weakness in rock chains; it is light, the design permits the use of long bolts, and knuckles and joints are relatively few. Adjustment is simple, and the adjusting nuts are locked while in working position. There is absolutely no wear on the bolts, and the expense of restoration to perfect condition is limited to the cost of new joints or couplings. We are happy to note that the catalogue is 6 x 9 inches, the dimensions recommended by the American Society of Mechanical Engineers in order that catalogues may be uniformly bound together for reference

Business Notices.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

THE ELECTRICAL COLLECTION AGENCY recently established at Birmingham, Ala., for the exclusive use of electrical manufacturers and supply dealers, will be welcomed by the trade. Much money has been lost in the South by the credit system being too liberally applied, and the object of the new agency is to protect the manufacturers and the trade generally. It is managed by a gentleman whose 14 years' connection with the Southern trade, coupled with the best of references, assures the accomplishment of its object.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JAN. 7, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

552,516. TELEPHONE SWITCH; G. W. Coy, Milford, Conn. App. filed March 15, 1895. In a telephone apparatus, the combination with a transmitting apparatus mounted to move in a fixed path, of switching levers mounted independently of the transmitter and its support, and located adjacent to each other in the path of movement of the transmitting apparatus to be operated by the insertion thereof between them.

552,521. ELECTRIC MOTOR; S. D. Field, Yonkers, N. Y. App filed June 27, 1892. The combination with the motor frame carrying the field magnets, of a support permitting a partial rotation of the motor frame, an armature and a brake device for the armature controlled by the support.

552,540. ELECTRIC METER; W. H. McGrath and J. M. Oram, Fort Wayne, Ind. App. filed July 8, 1895. The combination of an electric circuit containing translating devices, a rotating switch for cutting said translating devices in and out of circuit, a recording time-piece, including a motor-driven train of wheels, a flexible, vibratory spring having a free terminal in position to engage a wheel of said train, and a rotating cam mechanically connected to said switch, in position to engage said spring and force it into contact with a wheel when said cam is at one point of rotation and to release said spring upon a further movement.

552,548. APPARATUS FOR PROTECTING ELECTRICAL CIRCUITS; J. M. Oram, Dallas, Tex. App. filed June 4, 1895. The combination in an arrangement of apparatus for protecting electrical circuits, of an electric circuit, an indicator or alarm in said circuit, a signal transmitter at one point or station operating in said circuit to produce a predetermined effect, a second signal transmitter, at a second point or station, operating said circuit to produce an effect substantially equal and opposite to the effect normally produced by said first transmitter and means for normally operating said transmitters in unison.

552,553. PHASE-COMPLETING DEVICE; J. T. Sibley, Clinton, Can. App. filed March 28, 1893. In a circuit-changing device the combination with a switch provided with the bracket of an armature lever provided with a pivoted arm, the spring arranged in connection therewith, to throw the arm to one side or the other of the bracket as required.

552,574. ELECTRIC SWITCH; S. Bergmann, New York, N. Y. App. filed April 23, 1895. An electric switch or cut-out, provided with two or more pairs of line wire contacts whose acting faces lie in different planes; and a revoluble contact device having two or more ratchets arranged in different general planes, each ratchet having alternate conductive and non-conductive contact faces to which the corresponding pairs of line wire contacts are adapted.

552,594. ELECTRIC GAS-LIGHTING BURNER; J. E. Swendeman, Boston, Mass. App. filed June 7, 1895. In an electric gas-lighting burner the combination with the fixed electrode, of a movable electrode provided with a longitudinal slot and swinging on a fulcrum pin passing through said slot, said movable electrode being provided with a suitable terminal and having a notch in its lower portion, an oscillating disc or member having a pin or projection adapted to engage the said notch in the movable electrode and raise and swing the latter on its fulcrum to cause its terminal to make and break contact with the fixed electrode, and a spring for retracting the movable electrode after its release.

552,604. ELECTRIC RAILWAY SYSTEM; H. Brandenburg, Chicago, Ill. App. filed Oct. 5, 1894. In an electric railway the combination with the conduit having a slot, of a slot closer movable in a horizontal plane transversely of the slot connected with the conduit, and a trolley wire mounted on said slot closer at a point removed from the slot, but moving therewith when the slot is opened and closed and extending longitudinally of the conduit.

552,631. TROLLEY; Bert Dale, Milwaukee, Wis. App. filed May 9, 1895. The combination with a forked trolley arm having conical apertures, a hollow trolley wheel, a sleeve extending entirely through the wheel, conical bearings located in said sleeve and engaging the conical apertures aforesaid, and provided in their sides with longitudinal slots or recesses, and at their inner ends with tubular extensions, a spring located in said sleeve and having its ends seated in the tubular extensions of the conical bearings, and set screws passed through said wheel and sleeve and engaging the slots or recesses in the sides of the conical bearings.

552,658. JUNCTION FUSE AND SWITCH BOX; W. F. Bossert, Utica, N. Y. App. filed April 3, 1895. The combination of negative and positive pole-pieces insulated from each other, having means for attachment of main circuit wires, a series of local circuit, spring switches at each end of the local circuit having hollows in their adjacent sides and a rotary key for operating the spring switches and engaging in the hollow thereof.

552,680. ELECTRIC CUT-OUT AND INSULATOR; H. A. Wagner and F. Schwedtmann, St. Louis, Mo. App. filed Jan. 21, 1895. The combination with a transformer of an enclosing box or case of metal therefor, two metallic shells carried thereby, a line wire supporting insulator mounted on each shell, and a fusible cut-out in each shell interposed in the circuit between each line wire and the coils of the transformer.

552,689. TELEPHONE TRANSMITTER; I. J. Kusel, St. Louis, Mo. App. filed April 29, 1895. The improved telephone transmitter comprising a transmitting diaphragm arranged in a vertical plane, a horizontal stationary-shaped bracket fixed by a screw at a point immediately beneath the edge of, and extending at right angles to said diaphragm and having the opposite threaded apertures adjacent its free ends, pivot screws in said apertures, an arm having opposite bearings at its lower end and pivoted between the said screws and extending upwardly and inwardly to a point on a line with the centre of the diaphragm, threaded arms and formed integral with the upper end of said pivoted arm, one of the arms being horizontal and the other extending obliquely upward, a carbon button mounted on said arm and a weight mounted for adjustment upon the other one of said arms, the arms and button and weight being located interior of a vertical line drawn through the pivot point of said pivoted arm.

552,705. TELEPHONE SWITCH; G. W. Coy, Milford, Conn. App. filed April 9, 1895. In a telephone apparatus, the combination with the switches in the bell and receiver circuits, of the movable transmitting apparatus provided with means for actuating said switches, and a switch in the local circuit operated by the movement of the receiver.

552,723. MULTIPLE SWITCHBOARD FOR TELEPHONE EXCHANGES; C. E. Scribner, Chicago, Ill. App. filed March 5, 1892. The combination with two electromagnets permanently included in the same electric circuit, of means for interrupting the current through one of the magnets when simultaneously excited.

552,724. MULTIPLE SWITCHBOARD SYSTEM FOR TELEPHONE EXCHANGES; C. E. Scribner, Chicago, Ill. App. filed March 17, 1892. An electric annunciator provided with two independently pivoted armatures, one armature carrying a hook or detent adapted to engage with and retain the other armature, which serves as a drop or target, the armature carrying the hook being adapted to be operated by a less current than is required to operate and retain in position the armature which serves as a target.

552,725. SPRING-JACK FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed July 30, 1892. In a spring jack the combination, with a supporting plate of insulating material provided with a groove or channel in its under side, of a flat strip secured to the upper wall of said channel, said wall being provided with a downward projection in front of the end of said strip, a line spring beneath said strip, and a contact-anvil mounted upon the upper surface of said line spring and adapted to make contact with the under side of said strip.

552,726. SWITCHBOARD SYSTEM FOR TELEPHONE EXCHANGES; C. E. Scribner, Chicago, Ill. App. filed April 26, 1893. In an annunciator the combination with the indicator thereof adapted, to display a signal when released, of two electromagnets, armatures therefor, and catches controlled by the different armatures, one of said catches normally engaging with the said indicator, and the other normally disengaged therefrom, but adapted to be brought into engagement therewith when its magnet is energized.

552,727. ANNUNCIATOR FOR TELEPHONE SWITCHES; C. E. Scribner, Chicago, Ill. App. filed May 2, 1893. The combination with two helices connected in series in an electric circuit, one of the said helices being of high impedance of an armature common to said helices, the helices being arranged to operate differentially or oppositely upon the said armature, and a non-inductive resistance in shunt of the helix of high impedance.

552,728. MULTIPLE SWITCHBOARD; C. E. Scribner, Chicago, Ill. App. filed June 1, 1889. The combination with a telephone line, of a terminal plug connected therewith, a socket for said plug and switch with which the operator's telephone is connected, said switch having one of the springs or levers thereof projecting into the path of the plug when inserted in the socket to disconnect the telephone from the line, which on removing the plug the switch acts to bring said telephone into circuit.

552,729. SPRING-JACK SWITCH; C E. Scribner, Chicago, Ill. App. filed May 9, 1893. The combination with a telephone line of a spring-jack having four contact pieces arranged in two pairs, whose members are separable, one pair being included in each line conductor and a plug adapted to make connection with the four contact pieces.

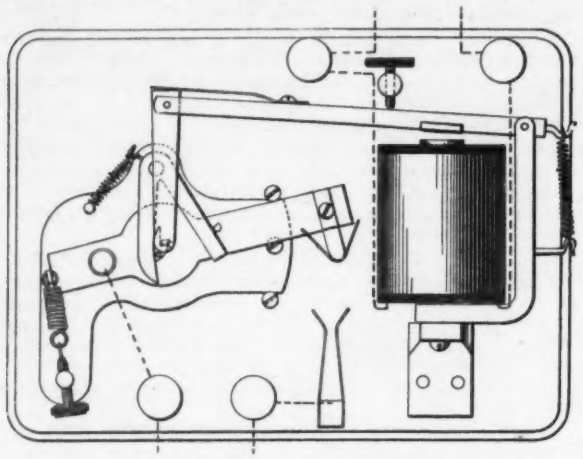
552,730. TELEPHONE CIRCUIT; C. E. Scribner, Chicago, Ill. App. filed June 16, 1893. In combination, two helices adapted to have E. M. Fs. induced in them, connected in series in the same circuit, and a receiving instrument adapted to respond to varying currents in parallel circuit with one of the secondary helices, said second mentioned helix being adjusted so that no difference of potential exists between the points from which the receiving instrument is branched.

552,733. AUTOMATIC ELECTRIC ALARM; T. J Stansel, Laredo, Tex. App. filed June 1, 1895. A switchboard consisting of a suitable base, a series of metallic strips embedded in the base, a second series of metallic strips arranged at right angles thereto, crank levers pivoted to the under strips at points between the intersecting upper strips, said crank lever making contact with the top strips, a bar on the upper edge of the switchboard connected with the battery, suitable connections between a bell and the bar, connections between the bell and the upper metallic strips, in combination with a clock having a series of wires protruding on the face, and connecting with the lower metallic strips, the minute hand making electric connections when in contact with the wires on the face, a second series of wires protruding in a manner to make contact with the hour hand and connected with the battery.

552,735. TRUNK LINE FOR TELEPHONE EXCHANGES; T. C. Wales, Jr., Boston, Mass. App. filed Aug. 24, 1895. The combination with a switching system comprising an annunciator-board containing a signal annunciator and a connection socket for each line, a multiple switchboard of several sections, each having a socket for each line, and trunk lines extending between the annunciator-board and each section of the multiple board, of means in connection with each trunk line for causing the display of a signal at the switchboard when connection is made with the trunk line at the annunciator-board, and for causing the display of a signal at the annunciator-board when the terminal of the trunk at the switchboard is returned to its idle position, the connection at the annunciator-board still existing; said means consisting in a circuit including the signaling instrument at the annunciator-board, controlled in the concur-

rent operation of switches of both ends of the trunk line, and a circuit including the signaling instrument at the switchboard, controlled by a switch at the annunciator-board.

552,738. PRINTING TELEGRAPH; J. E. Woodbridge, Duluth, Minn. App. filed Oct. 7, 1895. The combination with a printing shaft and the type-wheel of a constantly driven pulley having a frictional connection with said shaft, an armature normally holding said shaft stationary, a printing lever and paper feed mechanism actuated by the rotation of said shaft.



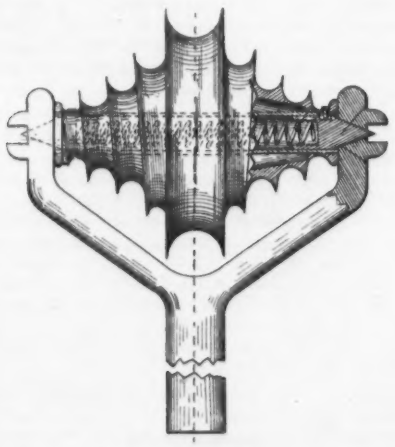
No. 552,553.—Phase-Completing Device.

552,746. LOCAL ALARM DOOR FOR SIGNAL BOXES; F. W. Cole, Newton, Mass. App. filed March 9, 1895. The toothing actuating wheel for the striking lever, combined with a locking device restraining it from rotation, an actuating spring therefor, a knob or equivalent device for extending said spring, storing up energy to actuate the wheel, and means for releasing said locking device after the knob has been turned a predetermined distance.

552,755. CONDUIT SYSTEM FOR ELECTRIC RAILWAYS; C. A. Gaines, New York, N. Y. App. filed May 1, 1894. In an electric railway of the character specified, the combination of a longitudinally movable rod, a cam shoe carried by the car for operating said rod, movable parts at opposite ends of said rod for receiving the thrusts of said shoe and communicating them to said rod, the one part acting oppositely to the other, and said rod divided into two sections, with an interposed spring expansion joint adapted to yield in case said rod is simultaneously acted upon by the shoes of the two successive cars.

552,756. ELECTRIC CIRCUIT CONTROLLER; H. A. Gorn, New York, N. Y. App. filed July 26, 1895. The combination with the armature and field helices and the conductors supplying the current, of a hand actuated switch, a circuit-changer and contact plates and rheostat and two electromagnets for moving the circuit-changer in opposite directions, the circuit being arranged as set forth, so that the circuit-changer breaks the circuit to its actuating magnet at the end of its movement and closes the circuit to the magnet acting in the other direction ready for the current to be turned on by the switch.

552,776. ELECTRIC SIGNALING; F. G. Pratt, Revere, Mass. App filed Aug. 20, 1894. In a railway signaling system, the combination of a signaling circuit, a series of two or more make-and-break mechanisms included in said signal circuit and arranged to operate in a certain predetermined order to affect a restoration of the signal circuit and a series of track instruments for operating the make-and-break mechanisms in such predetermined order.



No. 552,631.—Trolley.

552,803. AUTOMATIC ELECTRIC ALARM; G. B. Williams, Texarkana, Tex App. filed April 8, 1895. In an electric alarm the combination of a casing, a diaphragm therein, a stem connected to the diaphragm, means for applying a regulated spring pressure on one side of the diaphragm and a fluid pressure on the other side thereof, a contact piece, a contact finger connected to the stem and adapted to be moved in contact with the contact piece by the same, and a spring independent of the spring employed for actuating the diaphragm connected to the finger and adapted to hold the same normally out of contact with the contact piece.

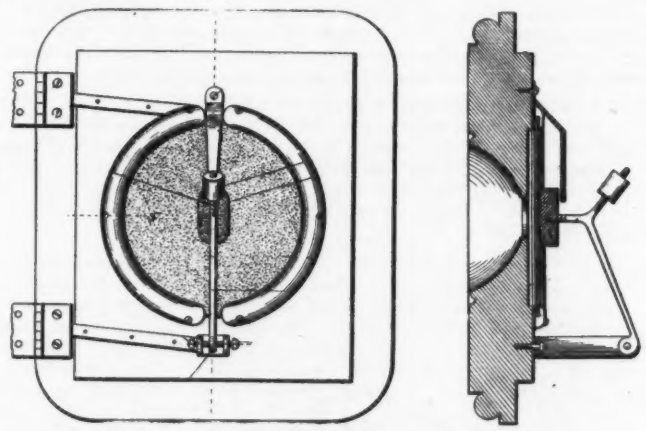
552,811. VALVE-CONTROLLING DEVICE; J. F. Batchelor, Brooklyn, N. Y. App. filed July 23, 1895. In a valve-controlling device, the combination with a main-balance valve of an auxiliary valve having a valve-stem carrying a perforated slide-valve and a disc-valve, adapted to simultaneously control the supply and exhaust of pressure to one side of the main-valve an electromagnet in circuit, and means to control said circuit, and an armature for said magnet secured to the auxiliary-valve stem.

552,816. TELEPHONE; N. L. Burchell, Washington, D. C. App. filed Oct. 29, 1895. The combination, with a telephone, of an electric lamp and lamp circuit, and means operated by movement of the telephonic apparatus to the position of non-use for opening the circuit to extinguish the lamp.

552,823. TELEPHONE SYSTEM; F. R. Colvin, New York, N. Y. App. filed Feb. 2, 1895. The combination with a number of telephone lines extending to the central station, of a cord connector for connecting the circuits together for conversation, an induction coil having the secondary connected in series with the said cord connector, and a telephone transmitter and receiver in circuit with the primary of said induction coil, whereby the telephone set may remain continuously in operative connection with the cord connector.

552,832. INSTRUMENT FOR TREATMENT OF STRICTURES BY ELECTROLYSIS; J. A. Fort, Paris, France. App. filed Nov. 7, 1895. An instrument for treatment of strictures, said instrument comprising a non-conducting sound, a bowed platinum wire or wires projecting from the side thereof, and a conductor extending from said platinum wires through the sound to a connection device or terminal on the handle.

552,858. ELECTRIC MOTORS; G. L. Thomas, New York, N. Y. App. filed March 19, 1895. The combination with a motor operated by gas pressure, of a closed reservoir containing a volatile fluid, a conductor in said fluid, a source of electricity in constantly closed circuit with said conductor, whereby said conductor is heated and gas under pressure is continuously produced, a condensing chamber, and a valve between said condensing chamber and said reservoir, the said valve being constructed to open at a determinate gas pressure, and so to permit a flow of gas from said reservoir directly to said chamber.



No. 552,689.—Telephone Transmitter.

552,865. TELEPHONY: F. R. Colvin, New York, N. Y. App. filed Jan. 14, 1895. In a telephone circuit, the combination with two limbs or lines extending between two telephone sets, of two branches or bridges, each containing a battery and a microphone or battery transmitter, and two parallel branches each containing a receiver, whereby the battery current through each transmitter finds path over the two receiver branches in parallel to thus decrease the resistance of the battery circuit through the microphone while incoming currents transverse the receiver instead of the branch containing the transmitter.

552,866. TELEPHONE SWITCH; G. W. Coy, Milford, Conn. App. filed April 1, 1895. In a telephone apparatus, the combination with switch mechanism therefor, of a transmitting apparatus movably mounted for the operation of said mechanism, and a signal, operated by replacing the receiver to warn the user to move the transmitting apparatus into switching position.

552,867. DESK TELEPHONE APPARATUS; G. W. Coy, Milford, Conn. App. filed April 1, 1895. In a telephone apparatus, the combination with switch mechanism thereof, of transmitting apparatus of which the transmitter is in a fixed position, and a speaking tube leading thereto and provided with an air stop or valve and adapted to operate the switch mechanism.

552,874. ELECTRIC ARC LAMP; W. S. Bartholomew, Chicago, Ill. App. filed Sept. 23, 1895. In an electric lamp having its arc localized the combination with a pair of frame posts, a cross-plate from which such posts depend, and an apertured cross-plate uniting such posts immediately above the arc, of a pair of guide-rods extending between such upper and lower cross-plates, a pair of guide-rods secured to the frame immediately below the arc and extending downwardly, a traveler mounted to slide upon each pair of guide-rods, the upper traveler being counterweighted, flexible connection between the two travelers, sheaves at the upper portion of the lamp-frame over which such flexible connection is hung, a carbon holder or clamp for co-operating with each traveler, ball-and-socket joint connection between the travelers and their co-operating holders, apertured guide-plates immediately above and below the arc adapted to prevent the angular movement of the carbon pencils.